A Taxonomic Revision of *Bryum capillare* Hedw. and related species.

Summary of Ph.D. Thesis submitted to the University of Glasgow

by Hadiuzzaman Syed, M.Sc.

A taxonomic revision of the moss *B. capillare* Hedw. and the species commonly confused with it has been carried out. It has been found to be a complex of eleven species and one variety. These are: *B. capillare* Hedw. var. *capillare*, *B. capillare* Hedw. var. *rufifolium* (Dix.) Podp., *B. elegans* Nees ex Brid., *B. stirtonii* Schimp., *B. subelegans* Kindb., *B. flaccidum* Brid., *B. laevifilum* Syed, *B. pseudocapillare* Besch., *B. erythroloma* (Kindb.) Syed, *B. albo-limbatum* (Hamp. et C.Muell.) Jaeg., *B. torquescens* Bruch., and *B. jamaicanse* Syed. *B. laevifilum* and *B. jamaicanse* have been described as new species. All have been fully described and figured and their geographical distribution recorded.

Efforts have been made to distinguish the species while they are sterile, for most of the species in the *capillare* group do not fruit frequently. Tubers and axillary filamentous gemmae have been found to be important characters for sorting out the various species in the vegetative condition. Rhizoid characters have been found to be important for distinguishing *B. elegans* from other species in the group.

Studies on the ornamentations of the spore walls of the different species under the Scanning Electron Microscope have revealed that there are differences between them which are taxonomically significant.

Studies of the geographical distribution of the species showed that *B. erythroloma*, *B. pseudocapillare* and *B. jamaicanse* are restricted to

North America, B. albo-limbatum is an Australian species, B. elegans and B. subelegans are reported only from Europe and the rest of the species are found in several continents.

The arrangement of the antheridia in the various species has proved interesting. In some of them the antheridia are borne terminally, which is the normal situation. In others there are both terminal antheridia and antheridia in the axils of the perigonial bracts. Axillary antheridia have previously been reported only in Sphagnum and in paroecious mosses, and their discovery in Bryum raises the question of whether their primitive position in mosses is lateral or terminal.

The examination of the type specimens of species that have been reported as synonyms with B. capillare showed that several were not in fact closely related to it. Some of them proved to belong to other sections of the genus, but two, Bryum moravicum Podp. from Czechoslovakia and B. gemmascens Ren. et Card. from North America, belong to the same section (Trichophora) as B. capillare though not closely related to it. They appear to be good but neglected species and have both been fully described and figured.

A TAXONOMIC REVISION

OF

BRYUM CAPILLARE HEDW. AND RELATED SPECIES

Thesis submitted to the University of Glasgow

for the degree of Doctor of Philosophy

in the Faculty of Science

by

HADIUZZAMAN SYED, M.Sc.

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1 9 7 2

CONTENTS

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INTRODUCTION

The object of the present work is to provide a clear picture of *B. capillare* Hedw. and the species most closely related to it. It is one of the most abundant and most variable species of the genus *Bryum*. It and its close relatives are to be found in almost all parts of the world, and thus any revision of the group must be on a world scale. This has been attempted here, though naturally more material has been studied from Europe than from the other continents.

Many authors have described varieties of *B. capillare* Hedw. or species that they have segregated from it. Many of those are based on sterile material and most are now generally regarded as synonyms or at most varieties of *B. capillare*. Two that are unanimously accepted as good species are *B. donianum* Grev. and *B. canariense* Schimp. For this reason, though closely related to *B. capillare*, they are not considered in detail here, though they are included in the key. The mosses with which this work is concerned are those that are both closely related to *B. capillare* and commonly confused with it.

There have been few previous studies of the group as a whole. Arnell (1896) and Podpěra (1950, '51, '54) published papers on this species. Their works have been found useful, but I have been unable to accept their taxonomic conclusions. They paid little or no attention to the tubers or rhizoids, which I have found very important in sorting out the species. Podpěra accepted a large number of taxa under *B. capillare*, which I have found somewhat illogical and superfluous.

Ochi (1957, '59, '67, '69, '70, '72) has published several works dealing with this species and the others related to it. His publications have also been very useful, particularly in indicating a close relationship to, or possible synonymy with *B. capillare* for a number of species for which

this is not indicated in the Index Muscorum. Unfortunately, he does not mention anything about tubers, gemmae or rhizoids and has paid much attention to the leaf characters, which I have found to be less reliable. I have not been able to agree with all his taxonomic conclusions.

Ochi (1972) in his recent work on African Bryoidae has included a number of new synonyms of B. capillare. This was published too late for me to get the type specimens and to comment on those species.

Little use has been made hitherto of characters drawn from the gemmae in B. capillare. Whitehouse (1966) seems to have been the first to report the occurrence of tubers in B. capillare. The shape and colour of the tubers are not the same in all the species. The occurrence of axillary filamentous gemmae is one of the main characteristic features of B. flaccidum Brid., B. laevifilum Syed, B. subelegans Kindb., B. pseudocapillare Besch., and B. albo-limbatum (Hamp. et C.Muell.) Jaeg., while in others there are tubers only and no axillary filamentous gemmae, but B. stirtonii Schimp. bears no tubers or axillary filamentous gemmae at all. In B. capillare sometimes the tubers are lacking and in B. elegans they are very rare. The question may arise whether these characters are constant or not. Firstly, the conclusions have been made on the basis of large numbers of specimens collected from different parts of the world. Secondly, an effort was made to solve the question by growing the plants in similar conditions. For want of suitable materials all the species could not be grown together. Only B. capillare Hedw. var. capillare, B. torquescens Bruch., B. elegans Nees, B. flaccidum Brid., B. laevifilum Syed and B. pseudocapillare Besch. were grown in conditions of approximately constant temperature and illumination on a modified Knop's agar medium (A.C.C. and E. Nyholm 1964) (KCl, 60mg.; $MgSO_4$ $7H_2O$, 90mg.; $Ca(NO_3)_2$ $4H_2O$, 100mg.; KH_2PO_4, 60mg.; $NaNO_3$, 36mg.; ferric tartrate, 6mg.; agar-agar, 2g.; distilled water, 100ml.). Protonema grown in this medium readily

produced leafy shoots, tubers and axillary filamentous gemmae in the species accounted for, excepting in B. elegans. It produced rhizoids and leafy shoots in cultivation but did not produce any tubers. Specimens of B. capillare which are apparently non-gemmiferous produced tubers in cultivation. Species with axillary filamentous gemmae produced characteristic axillary gemmae in cultivation and thus gave a positive evidence that the occurrence of axillary filamentous gemmae is not due to ecological conditions. It has also been observed in herbarium specimens that the production of tubers or gemmae is greater when the plants are in the vegetative condition than when they are in fruit.

The use of rhizoid characters is rare in the identification of mosses. But, they are sometimes of great importance for the purpose. They have been found to be efficient in sorting out the species in B. erythrocarpum complex (Crundwell & Nyholm, 1964). I have also found the rhizoid characters useful here; for example, the rhizoid of B. elegans Nees is very coarsely papillose and the papillae are $\pm$ spine-like, while in others it is finely papillose and the papillae are $\pm$ blunt.

Leaf characters have also been found to be important in distinguishing the species, but as they show a great deal of variation, it is not wise to be certain on any character unless it is based on large numbers of specimens of different ecology. My decision has been made on each character after examining a large number of specimens, excepting for those which are very rare; for example, I have been able to examine only four packets of B. subelegans and three packets of B. albo-limbatum, but in these cases the characters were so distinct that I could not but agree that they are distinct species. In all the descriptions characters have been drawn from the leaves at the middle portions of stems of matured gametophytes.

Sporophyte characters have been useful too, but much less so than those of the gametophytes, because most of the species do not fruit frequently.

Among the group, B. torquescens is the most frequent fruiter. No fruit has been recorded for B. subelegans. B. flaccidum and B. laevifilum are mostly sterile; only a few packets of fruiting specimens of these have been recorded.

In the genus Bryum as a whole, abnormalities in sporophytes are of frequent occurrence. In abnormal sporophytes the capsules are variable in shape and size and are often asymmetric, the peristome is often malformed and the spores are very variable in size. B. deciduum Amann can be cited here as an ideal example for abnormality. In this the spores are reported as highly variable (from 15 - 30μ in diam.) and the figure of the peristome teeth (Amann 1933, p.72) is a perfect illustration of the abnormality which is often found in Bryum. In B. capillare this sort of abnormality seems to be rare. Out of a few thousand specimens, there were very few that I could not determine with confidence. One of the best examples of abnormality that I have found is in one Japanese specimen (page 38). It is not possible to give a correct explanation for this now, but most likely it is a hybrid, or of hybrid origin.

I haye not done any cytological work on any of the species. According to Smith and Newton (1967) the chromosome number in B. capillare is n = 10. Others have counted different numbers, e.g., n = 10 by Gangulee and Chatterjee (1962) from India, n = 10 by Sannomiya (1957) from Japan, n = 20 by Al-Aish and Anderson (1960) and Anderson & Al-Aish (1963) both from Arizona, n = 10 + 1 by Steere et al. (1954) from California.

The number n = 10 for B. capillare is clearly well established but it is quite possible that the other counts, n = 20 and n = 10 + 1 may have been based on B. torquescens or some other 'member' of the group, and confirmation of the existence of these numbers in B. capillare is desirable. There have been no reports of chromosome counts for any other species of the group.

The geographical distribution of the group seems to be an interesting feature. B. albo-limbatum is an Australian species; B. erythroloma, a North American species which has been recorded only from British Columbia and adjacent regions. I have recorded B. jamaicanse from Jamaica, Guatemala and Mexico. B. pseudocapillare is a species which seems to be restricted to the southern part of North America. B. elegans and B. subelegans have been recorded with certainty only from Europe. The rest of the species in the group are recorded from several continents.

I have tried to see the type specimens of B. capillare and all other closely related species of which the names are legitimate. A number of type specimens have not been located and for those I have not been able to be certain about, are placed under doubtful species. For the illegitimate species, I have not tried hard to get the type specimens as they would have had no effect on the nomenclature.

I have not attempted to examine the types of all the subspecies and varieties of B. capillare and related species. Their identity would not affect the nomenclature of any of the species. I have seen a sufficiently wide range of material to indicate that if there are additional taxa in the group (at least from Europe, from which most of the varieties have been described) they must be rare.

For the distributional data of the species, the specimens examined, limited to a single record from each vice-county, province or other geographical unit, following present-day boundaries, have been listed after each species. For British records vice-county numbers are given in parentheses. The locations of the specimens have been indicated by means of the Index Herbariorum abbreviations, for the private herbaria and for specimens collected by living bryologists, the owner's initials.

Unless otherwise stated, the following characters which are true to all the species included in this work, are not repeated in the descriptions:

Outer peristome teeth yellow with reddish tinge at the base, paler above; striations on the outer surface of the teeth not forming any definite pattern. Inner peristome teeth gradually tapering towards the upper end, usually colourless but sometimes tinged with yellow; papillae on the outer surface of the teeth minute, heavily crowded; cilia large, apendiculate.

CHAPTER 2

Section I

KEY TO THE SPECIES

1 Filamentous gemmae present in the axils of leaves. 2

Axillary gemmae absent. 6

2 Axillary gemmae smooth. 3

Axillary gemmae papillose. 4

3 Rhizoids finely papillose; axillary gemmae reddish brown; tubers orange or pinkish orange; midrib usually reaches to apex. 7. B. pseudocapillare.

Rhizoids ± smooth; axillary gemmae brown; tubers dark brown; midrib usually ceases below apex. 6. B. laevifilum.

4 Margin of the perichaetial leaves coarsely toothed; leaves nondecurrent. 9. B. albo-limbatum.

Margin of the perichaetial leaves entire; leaves decurrent. 5

5 Axillary gemmae finely papillose; tubers dark brown; nerve broad at base, narrow at apex. 5. B. flaccidum.

Axillary gemmae coarsely papillose; tubers absent, nerve broad up to apex. 4. B. subelegans.

6	Leaves decurrent.	7
	Leaves nondecurrent.	8
7	Leaf cells distinctly porose, border not distinct; tubers absent.	3. B. stirtonii.
	Leaf cells rarely porose, border distinct; tubers orange to maroon.	8. B. erythroloma.
8	Rhizoids very coarsely papillose; leaf cells distinctly porose.	2. B. elegans.
	Rhizoids finely papillose; leaf cells rarely porose.	9
9	Leaves in interrupted tufts on stem, not bordered above.	B. canariense.
	Leaves not in interrupted tufts, distinctly bordered.	10
10	Leaf border bistratose.	B. donianum.
	Leaf border unistratose.	11
11	Tubers red.	12
	Tubers brown to reddish brown.	13
12	Tubers red or crimson, their cells either nonprotuberant or protuberant; nerve always excurrent.	10. B. torquescens.
	Tubers red or reddish orange, with long projecting mamillae; nerve nonexcurrent.	11. B. jamaicanse.

13 Leaves obovate-spathulate, cuspidate to piliferous, border narrow and thin. — 1a. *B. capillare* var. *capillare*.

Leaves (except the lowest) narrow, spathulate, very longly piliferous, border distinctly wide and thick. — 1b. *B. capillare* var. *rufifolium*.

Section II

1. Bryum capillare Hedw., Spec. Musc. 182. 1801

Plant densely or loosely tufted, green, sometimes tinged with red, rarely maroon, deep reddish or variegated, soft, 1 - 5 cm high, repeatedly branched. Central strand of stem 25 - 55 μ in diameter.

Rhizoids brown to deep reddish brown, papillose. Tubers usually on long rhizoids, never axillary, the same colour as the rhizoids, abundant to scattered, round, 66 - 270 μ (-440 μ) in diameter or oval or irregular, ranging from 65 - 250x105 - 350 μ, their cells not protuberant.

Leaves densely or loosely set, soft in texture, obovate-spathulate, sometimes very narrow at the base, rarely narrowly and longly acuminate, plane or concave, slightly curved towards the direction of twisting, when dry usually much shrinking, strongly spirally twisted round the stem with the points flexuose, ranging from 0.8 - 4 mm in length; nerve sometimes very strong, excurrent in a cuspidate to very long, glossy, piliferous apex, sometimes in cuspidate or mucronate leaves vanishing below the summit, usually green but sometimes light brown to reddish brown or red; margin finely toothed above or entire and wavy, variously recurved; border distinct, consisting of 3-7 rows of narrow elongated thick-walled cells, usually not coloured but sometimes tinged with red or yellow. Basal cells broadly rectangular, 15 - 37 x 32 - 135 μ; upper cells ± rhomboid hexagonal, thin-walled, 12 - 22 x 32 - 91 μ; cells rarely porose.

Dioecious. Perichaetial leaves green, narrow-lanceolate with long piliferous apex; margin entire and recurved; nerve excurrent; female paraphyses not coloured. Perigonial leaves much smaller than the vegetative leaves, ranging from 0.8 - 1.5 mm in length, broadly ovate, concave, awl-shaped, bright orange or reddish, sometimes paler; nerve non-excurrent; male paraphyses bright orange, apical cell of the male paraphyses with round tip. Antheridia in the axils of perigonial leaves as well as at the tips of branches.

Seta 2 - 3 cm long, lower portion light brown to deep brown or red, upper portion light brown to brown; without any differentiated layer of cells around the central strand.

Capsule subcylindrical to pyriform, 2.5 - 5 mm in length (without lid), with a distinct neck, cernuous, strongly contracted below the mouth when dry, symmetrical, light brown to reddish brown, mouth deep brown to deep reddish brown, glossy; neck distinctly shrunken when dry; exothecial cells at the mouth forming 4-6 rows of short cells, not in longitudinal rows, not forming any layer of transversely elongated cells, cells below the mouth, not in longitudinal rows, 15 - 34μ in breadth. Lid orange-red, sometimes paler, conical-apiculate, cells arranged in concentric layers, 9 - 32μ in breadth.

Spores 9 - 12 - 15μ in diameter.

1a. var. capillare (Figs.1-4)

B. baueri Hamp., Linnaea 30:457.1860.

B. teneriffae Hamp. in C.Muell., Bot. Zeit. 20:12.1862.

B. chilense Reichdt., Reise Oest. Freg. Novara Bot. 30:175.1870.

B. rufo-nitens Hamp., Vid. Medd. Naturh. For. Kjeobenh. ser. 3, 9-10:261.1878.

B. nanocoma C.Muell., Linnaea 43:365.1882.

B. squarrosum Kindb. in Roell, Hedwigia 35:66.1896(non Hedw.,1801) hom. illeg.

B. streptophyllum Kindb., Eur. N. Am. Bryin. 2:359.1897.

B. nagasakense Broth., Hedwigia 38:219.1899.

B. baileyi Holz., Bryologist 8:54.1905, hom. illeg.

B. fosteri Holz., Bryologist 8:80.1905.

B. tosanum Card., Bull. Soc. Bot. Genève, ser. 2,1:128.1909.

B. validicostatum Card. et Dix., Journ. Bot. 49:4.1.1911.

B. rhomboidale Thér., Rev. Bryol. n. ser. 3:37.6.1930.

B. vino-viride Bartr., Bishop Mus. Bull. 101:116.82.1933.

Leaves densely or loosely set, soft in texture, obovate-spathulate, sometimes very narrow at the base, plane or concave, slightly curved towards the direction of twisting, when dry usually much shrinking, strongly spirally twisted round the stem with the points flexuose, ranging from 0.8 - 4 mm in length; cuspidate or piliferous with excurrent often reflexed nerve, sometimes in cuspidate or mucronate leaves, nerve vanishing below the summit, nerve usually not coloured but sometimes light brown to reddish brown or red; margin generally finely toothed above, sometimes entire, variously recurved; border distinct consisting of 3-5 rows of narrow elongated cells, usually not coloured but sometimes tinged with red or yellow. Basal cells broadly rectangular, 16-31 x 32-88μ; upper cells

rhomboid hexagonal, short, rather wide, thin-walled, 16-25 x 38-60μ; cells rarely porose.

B. capillare shows a wide range of variations in the shape and size of leaves. An extreme deviation from the normal obovate-spathulate shape can be observed in the Japanese capillare, which is described as B. capillare Type-1 (Ochi 1957). Here the leaves are ± ovate, short-acuminate, promptly narrowed towards the base. Ochi (1957) placed it as var. flaccidum under B. capillare. I have seen similar specimens of B. capillare in Europe and the British Isles (Fig. 4,c-e) as well as in North America and a good range of intergradations of it. In European herbaria also, this narrow-leaved form of B. capillare is often identified as var. flaccidum, but in fact B. flaccidum can be easily distinguished from it by the presence of its filamentous axillary gemmae, the size of its tubers and the decurrence of its leaves. I think that it does not deserve to be distinguished taxonomically from B. capillare var. capillare.

B. capillare grows on widely varied habitats, such as on tree trunks and tree boughs, in the crevices of rocks, on old walls, in arable fields, on sandy soil and very rarely on limestone rocks.

B. capillare is almost cosmopolitan in its distribution. I have made no special effort to determine its exact limits of distribution throughout the world, but I have seen specimens as follows: almost all over Europe (southern and central Europe, to the north up to Finnmark in Norway, to the west up to British Isles); in North America from British Columbia and Maryland to Mexico (apparently rare in Mexico, Florida, Louisiana and Georgia), from Hawaii; in South America I have recorded it from Brazil, Argentina and Chile; in Africa from Tenerife, Morocco, Belgian Congo and South Africa; in Asia from Japan; in Australia from New South Wales and in New Zealand from Otago.

B. capillare is a common moss over much of its range, a vast number of specimens has been examined and there would be no object in listing them all. The list below includes a selected number to illustrate the limits of the range of the species, as far as I have determined them, as well as all type specimens examined.

Representative Specimens Examined :

Without locality, c.fr. (type of B. capillare Hedw.) (G).

Europe. Norway: Finnmark, Talvik, July 1890, herb. E. Jørgensen (O).

Africa. Tenerife: Agua Garcia, alt. 2500 (type of B. teneriffae Hamp.) (BM); Baranco del Rio, c.fr., Feb.1909, (no.19), Dr. Salter (iso-type of B. validicostatum Card.) (BM). Morocco: M.Ifrane, on stony calcareous soil, c.1700m., c.fr., April 1969, P. & J. Davis, (no.49306) (E). Belgian Congo: Camp Rueru, Mt. Mikeno, 2900m., Mar. 1929, Dr. Linder (type of B. rhomboidale Thèr.) (S-PA). South Africa: Drakensberg, Sugela Valley, c.fr., July 1947, E.A.C.L.E. Schelpe, (no.2135) (OXF).

Japan. Kyushu: Nagasaki, auf Stein am Waldbach (n.1386 a.b.c.), c.fr., January 1861, Wichura (type of B. nagasakense Broth.) (H). Shikoku: Tosa, Mont. Honokawa, c.fr., 1904, Okamura (type of B. tosanum Card.) (S-PA). Honshu: Pref. Yamagata, Fukura, on rocks affected by cement construction, ca. 300m. alt., c.fr., Aug.1955, H. Ochi (GL). Hokkaido: Prov. Kitami, Mt. Shari, on soil in forest, 1100 - 1500m. alt., July 1956, H. Ochi (GL).

Australia. New South Wales: Blackheath, c.fr., Oct.1900, Hamilton (S-PA).

New Zealand. Otago: Mabarora Valley, dry river gravel by stream, Pipens Creek, ca.1200ft. alt., c.fr., Dec.1964, J.T. Linzey (no.3256) (GL).

North America. Canada: British Columbia, Victoria; rocks, George Vale, Feb.1931, E.C. MacKenzie, (no.42) (MICH). On rocks in woods, Hastings, April 1889, J. Macoun (type of B. streptophyllum) (CAN).

U.S.A.: Arizona; Pima Co., Soldiers canyon, Mt. Lemmon Rd., Santa Catalina mts., on granite rock, woods, 7000ft., Aug.1949, I.M. Haring (no.9014) (MICH). California; In mont. Sierrae Nevadae, Bauer (type of B. baueri Hamp.) (BM). Oregon; Astoria, c.fr., July 1888, (no.275) Röll. (type of B. fosteri Holz.) (S-PA). Arkansas; Rock ledge, steep river bluff, Knopper's Ford, Jack Creek, east of Waldron, Ouachita mts., May 1953, L.E. Anderson (no.11554) (MICH). Tennessee; Sevier Co., on moist rock, pinnacle near Greenbrier, alt.4000ft., June 1934, A.J. Sharp (MICH). Virginia; Madison Co., Old Rag mountain, alt.3200ft., June 1944, I. Schnooberger (MICH). Maryland; Garrett Co., moist rocky soil on steep, wooded bank of Big Run, near confluence with Savage River, July 1962, F.J. Hermann (MICH).

Mexico: Tamaulipas; near Rancho del Cielo, Sierra de Guatemala, ca.3500ft., Aug.1950, H. Crum (no.1625) (MICH).

Hawaian Islands: Kauai; shaded rocks near Kokee, c.fr., elev. ca.4000ft., Feb.1930, E.B. Bartram (type of B. vinoviride Bartr.) (FH).

South America. Chile; Valparaiso, coll. Telinek (isotype of B. chilense Reichdt.) (BM). Argentina; Rio Seco prope Sn. Andres (isotype of B. nanocoma C. Muell.) (BM). Brazil; Rio de Janeiro (no.7419) (type of B. rufonitens Hamp.) (BM).

1b. var. rufifolium (Dix.) Podp., Act.Ac.Sc.Nat.Morav. 22:460.1950 (Fig. 5)

B. rubicundum Stirt., Trans. Bot. Soc. Edinburgh 26:246.1914 (non C. Muell.,1859), hom. illeg.

B. capillare Hedw. ssp. rufifolium Dix., Stud. Handb. Brit. Moss. ed. 3:368.1924.

Plant densely tufted, deep reddish, green or variegated. Leaves densely set, very narrowly and longly acuminate, when dry shrunken and contorted, sometimes loosely or strongly spirally twisted round the stem, ranging from 2.5 - 4 mm in length; nerve very strong, excurrent in a very long, glossy, piliferous apex. Sometimes the lower leaves obovate-spathulate like B. capillare Hedw. Margin finely toothed or wavy; border extremely wide, consisting of 5-7 rows of narrow elongated, incrassate cells. Basal cells $\pm$ rectangular, 15-37 x 37-135µ; upper cells $\pm$ hexagonal, 12-22 x 32-91µ; cells very rarely porose.

Male inflorescence not found.

England: Crevice of wall, West Horrington (6), c.fr., June 1967, J. Appleyard (as B. obconicum). On dry rocks, Knowle Hall, Bawdrip (6), c.fr., Aug. 1967, J. Appleyard (as B. obconicum). Stanner rocks (43), March 1955, E.F. Warburg (OXF). In shallow crevices of limestone rocks, limestone pavement, Llangestenin, near Llandudno (49), May 1952, R.E. Parker (GL). Llangollen, N.Wales (50), Barker.

Scotland: Acid rock ledges of old raised cliff between Port Appin and Airds Bay, Argyll (98), Sept. 1968, No. M.2421 J.P.M. Brenan (GL). Sea cliffs, Wreck Bay, Rhum (104), Aug. 1945, W.A. Clark & R.B. Cooke. Plockton, Ross-shire (105), Sept. 1913, Stirton (Type of B. rufifolium) (K). On limestone rocks, Cnochan, West Sutherland (108), Aug. 1957, E.C. Wallace

Ireland: Limestone rocks, Black Head, Co. Clare (H.9), May 1953, M.C.F. Proctor (GL).

The specimens of V.C. 50 and 104 have not been seen by me.

Dixon (1924) treated this plant as a subspecies under B. capillare Hedw. Excepting the leaf the plant resembles in all other characters B. capillare. The leaf border seems to be fairly constant in all the gatherings investigated. In some plants the leaves show a fairly good range of transition from obovate-spathulate to very narrowly acuminate, with longly piliferous, strongly excurrent nerves. Sporophytes have been seen in two gatherings only and found to be the same as those of B. capillare. Under these conditions, I feel that it should be kept as a variety under B. capillare Hedw.

B. platyloma Schwaegr. is a species described from Madeira. Ochi (1972) has seen the type of it and illustrated it in his paper. The main constant feature of it is the leaf border which is several rows of cells in thickness as in var. rufifolium. Though var. rufifolium is not known from any place outside the British Isles, yet it may well be that B. platyloma and B. capillare var. rufifolium are synonyms.

2. Bryum elegans Nees ex Brid.,Bryol.Univ.1:849.1826 (Figs.6,7)

B. ferchelii Funck. ex Brid., Bryol. Univ. 1:847.1826.

B. capillare Hedw. var. cochlearifolium Brid., Bryol. Univ. 1:666.1826.

B. capillare Hedw. var. ferchelii (Brid.) B.S.G., Bryol. Eur. 4:130.369ε. 1839 (fasc. 6-9 Mon. 60. 39ε).

B. cochlearifolium (Brid.) Hartm., Handb. Skand. Fl. ed. 4:411.1843.

B. haistii Schimp., Syn. ed. 2:449.1876.

B. capillare Hedw. ssp. elegans (Nees ex Brid.) Lindb., Musci Scand. 16.1879.

B. capillare Hedw. var. elegans (Nees ex Brid.) Husn., Musc.Gall. 241.1889.

B. elegans Nees ex Brid. var. ferchelii (Brid.) Breidl., Laubm. Steierm. 132.1891.

B. capillare Hedw. ssp. haistii (Schimp.) Kindb., Eur. N. Am. Bryin. 2:358.1897.

B. capillare Hedw. ssp. ferchelii (Brid.) Kindb., Skand.Bladmfl. 1904.

B. capillare Hedw. var. haistii (Schimp.) Podp., Consp. 352.1954.

Plant densely tufted, with long slender branches, reddish or green tinged with red, soft, usually julaceous, 1 - 4 cm high. Central strand of stem 15 - 35μm in diameter.

Rhizoids brown to reddish brown, very coarsely papillose. Tubers on long rhizoids, brown, round, with nonprotuberant cells, 90 - 200μ in diameter, very rare.

Leaves densely set, soft in texture, broadly ovate, distinctly concave, non-decurrent, when dry not shrinking, not twisted round the stem, rather closely appressed, sometimes loosely twisted only at the upper portion of the stem, ranging from 0.8 - 3.5 mm in length; nerve strongly excurrent, mucronate to piliferous; margin entire, wavy, not recurved; border narrow, consisting of 1 - 3 rows of narrow elongated cells. Basal cells ±

rectangular, 13-31 x 22-140μ; upper cells hexagonal, 13-28 x 25-63μ; cell walls distinctly porose.

Dioecious. Perichaetial leaves narrow-lanceolate, cuspidate; nerve excurrent; female paraphyses not coloured. Perigonial leaves smaller than the vegetative leaves, ranging from 0.7 - 1.5 mm in length, orange, concave; nerve excurrent; male paraphyses orange, few in number. Antheridia in the axils of perigonial leaves as well as at the tips of branches.

Seta 1.5 - 2.5 cm long, brown at the base, light brown at the upper portion. Seta shows a definite layer of cells around the central strand.

Capsule subcylindrical, 2 - 3 mm in length (without lid), with a distinct neck, cernuous, hardly contracted below the mouth when dry, symmetrical, light brown to brown, mouth deep brown, glossy, neck distinctly shrinking when dry; exothecial cells at the mouth arranged in longitudinal rows, cell walls equally thickened, 5 - 6 rows of short cells at the mouth, cells below the mouth arranged in longitudinal rows, 15 - 32μ in breadth. Lid light brown to orange, conical apiculate with blunt tip, cells not in concentric layers, 15 - 18 - 32μ in breadth.

Spores 9.5 - 12.5 - 15 - 15.7μ in diameter.

England and Wales: Between stones of walled bank, Lambourne, Perranzabuloe, West Cornwall (1), Dec.1945, F. Rilstone (B.B.S.). Among limestone rocks, Worlebury, Somerset (6), Feb.1967, J. Appleyard. Downs, Lewes, East Sussex (14), May 1899 and 1900, W.E. Nicholson (CGE). Great Doward, Herefordshire (36), April 1932, E. Armitage (B.B.S.). Under rocks on sloping ravine Water-break-its-neck, Radnorshire (43), April 1965, A.R. Perry and A.C. Crundwell (GL). On a dry rocky knoll, near Llangollen (50), Aug.1900, T. Barker (CGE). On limestone outcrops, Hill Fort near Llanddona, Anglesey (52), Mar.1963, Margaret Peel (B.B.S.). Near Buxton

(57), July 1878, T. Barker (CGE). Ingleborough, Yorkshire (64), July 1951, J. Appleyard. On limestone boulder in shade, north shore of Malham Tarn, Yorkshire (65), July 1970, A.C. Crundwell & H. Syed (GL). Calcareous wall, forest in upper Teesdale, Durham (66), Sept. 1958, E.M. Lobley (B.B.S.). The Bizzle, Cheviot, Northumberland (68), May 1950, R. Hall (UKD). Crevices of limestone cliff, Mickle Fell, Westmorland (69), July 1947, P.R. Bell (UKD). Crevices of rocks at about 2000ft., Ardale, Crossfell, Cumberland (70), June 1954, D.A. Ratcliffe (B.B.S.).

Scotland: On dry rocks, heathery carr, near St. Abb's Head, Berwickshire (81), April 1928, J.B. Duncan (UKD). Ben Lawers, Perthshire (88), Sept.1913, J.B. Duncan (UKD). With B. muehlenbeckii on boulder beside Dubh Lochan, Beinn a' Bhuird, Aberdeenshire (92), Aug.1964, J.A.Paton and A.J.E. Smith (B.B.S.). On limestone rocks, Creag Builg, Inchrory, Banffshire (94), June 1958, E.C. Wallace and A.C. Crundwell (B.B.S.). On dry limestone block at 3000ft., Ben Alder group, West Inverness (97), Aug.1957, D.A. Ratcliffe (B.B.S.). Ben Laoigh, Argyll (98), July 1908, R.H. Meldrum (E). On limestone rocks, Inchnadamph, West Sutherland (108), July 1899, W.E. Nicholson and H.N. Dixon (CGE).

Ireland: In mossy turf among limestone rocks, Gleniff, south of Cliffony, Sligo (H.28), Sept. 1970, J. Appleyard. On limestone boulders below Cromac Keagh's Hole, Eagle Rock, East of Benbulbin, Sligo (H.28), Sept.1970, J.A. Paton.

Iceland. Grimsey: On rocks and stones round Holatjorn, July 1934, E.W. Jones (OXF).

Norway. Buskerud: Ringerike, Norderhov, Szorvald, on limestone hill at Steinsfjorden, Sept.1894 (O). Sör-Tröndelag: Opdal, Kongsvold, July

1903, E. Ryan (O). Nordland: Sörfolden, Dypirk, Aug.1892, I. Hagen (O). Finnmark: Porsangerfjoord, Kolvik, July 1894, E. Ryan (O).

Sweden. Blekinge: Rough grazing by stone among grass, Listerhuvud, Mjallby, April 1922, S. Medelins (S-PA). Götland: Ramtrask, Etelhem, c.fr., June 1954, Åke Hovgard (GL). Västergötland: Limestone heath, Hogstena, Oct. 1920, A. Hulphers (S-PA). Bohuslän: On hill, south coast, Tjarno, c.fr., July 1928, P.A. Larsson (S-PA). Dalsland: Hill, Ramsberg, Skallerud, Sept.1938, P.A. Larsson (S-PA). Närke: Ad saxa calcarea, Axberg, July 1890, E. Jaderholm (S-PA). Södermanland: Dry earth on limestone, Morko, Oaxen, April 1957, E.V. Krusenstjerna (S-PA). Uppland: Angso National Park, Lana, 1935, H. Persson (S-PA). Västmanland: On limestone rocks in mixed Spruce forest near south end of Alvangen, Viker, July 1965, E. Nyholm, N. Hakelier & A.C. Crundwell (GL). Varmland: Rocks on shore by Vanern, Volgardesudde, Hammaro, June 1926, H.E. Johansson (S-PA). Dalarna: North of Tyfsingsjon, Idre, 745 - 800m., July 1928, T.G. Halle (S-PA). Medelpad: Aslo, Tyndero, June 1894, H.W. Arnell (S-PA). Jamtland: Frostviken, Sept.1907, A. Hassler (S-PA). Lycksele Lappmark: Ronas, Tarna, July 1937, C. Malmstrom (S-PA). Torne Lappmark: Jukkasjarvi, Abisko, Aug.1900, A. Tullgren (S-PA).

West Germany. Allgau: Schuttfeld am Daumen wege, 1800m., Aug.1909, I. Familler (S-PA). Ober Bayern: Berchtesgaden, c.fr., Sept.1895, Th. Suse (S-PA); In alpibus Berchtesgaden, n.d., Funck. (type of B. ferchelii Funck.) (B).

France. Hautes Pyrénées: Among rocks, R. des Tourettes, Aug.1959, E.F. Warburg (OXF). Hautes Alpes: In rock crevices towards col de Laurichard, Le Lautaret, July 1957, E.F. Warburg (OXF). Savoi: Peisey-

Nancroix, Rosuel, July 1950, Abbe Guillaumot (B.B.S.). Ain: Anfractuosites de rochers calcaires, pres du sommet, Cret de Chalam, 1548m., Sept.1953, Paul Cuynet (B.B.S.). Jura: Rochers parfois inondes, Source de l'Ain, 700m., Sept. 1962, Paul Cuynet (B.B.S.). Vosges: Rochers omberges, Neufchateau, n.d., Verheggen (S-PA).

Switzerland. Valais: In alpibus Valesiae et Sabaudiae, Thomas (type of B. cochlearifolium Brid.) (B). Vaud: Les Diablerets, c.fr., July 1895, W.E. Nicholson (CGE). In muris vinearum, prope Cressier ditionis neocomiensis (Neuchâtel) Helvetiae, Haist (type of B. haistii Schimp.) (S-PA). Ticino: Faido, Dalpe - Piumagna, 1300m., c.fr., June 1892, N.C. Kindberg (S-PA); Finsteraarhorn, 2700m., c.fr., June 1904, W. Trautmann (S-PA). Graubünden: Statzerhorn, c.fr., July 1888, N.C. Kindberg (as B. ferchelii) (S-PA). Glarus: On black humic earth in groove in limestone pavement near Murtschen, 1800m., Aug. 1947, E.W. Jones (B.B.S.). In Helvetiae orientalis alpibus in Lueg et Halach, c.fr., 1825, Lucas (type of B. elegans Nees ex Brid.) (B).

Austria. Tirol: Nordseitige Abbruche am Zugspitzgipfel bei 2960m., Wetterstein Gebirge, Sept.1954, J. Poelt (S-PA). Karnten: Melthicalpe im Malta Tal, 2300m., Aug.1880, J. Breidler (as B. elegans var. cochleariforme) (S-PA). Salzburg: Radstadter tauern, Aug.1894, Glowacki (S-PA). Steiermark: Kalkfelsblocke am hoyerberg im Ernsthal, 1200m., c.fr., July 1876, J. Breidler (S-PA).

Yugoslavia. Slovenia: Pieniny, ad rupes calcarias Káca, ca.450m, in Convalle fl. Dunajec, July 1937, Jan Smarda (as B. elegans var. ferchelii) (BRNM).

Italy. Como: Rochers calc., emergeant dans les paturages, mte. Boletto, au-dessus de molina (Lac de Como), 1000m., Aug.1898, F.A. Artaria (CGE).

Hungary. Borsod-Abauj: In rupestribus calcareis fissuris ad UPPONY, July 1934, A. Boros (S-PA).

Czechoslovakia. Bohemia: Stredocesky; Beroun, Ostium rivi kacak, 250m., April 1949, Z. Pilous (B.B.S.). Moravia: Blansko, ad rupes calc. muscosas preaeruptas vallis Suché údoli. May 1909, J.Podp. (as B. elegans var. rubrum) (BRNM); Kosouc pr. Stramberg, May 1904, J. Podpěra (as B. elegans var. longipilum) (BRNM); Adrupes calc. supra Mühle pr. Nikolsburg, April 1904, J. Podpěra (as B. capillare var. rubrum) (BRNM); Olomucium, Ad rupes calcareas Zkamenélé Zámky Jn. Konice, 750m. May 1905, J. Podpěra (as B. elegans var. transicus) (BRNM); Bilá hora pr. Stramberk, Sept. 1904, J. Podpěra (as B. elegans f. incontexta Podp.) (BRNM). Slovakia: Stredoslovensky, Tatra Magna, Pr. T. Kotlina s. calc., 1000m., July 1922, J. Podpěra (S-PA).

Poland. Krakow: Montes Tatri occ., Vallis Dolina kondratowa, declivitas montis kalacka Turnia. Ad saxa calcarea lucida, 1260 m.s.m., Aug. 1957, S. Lisowski (S-PA). Bialystok: silva primitiva puszcza Bialowieza, April 1958, S. Lisowski (S-PA).

U.S.S.R. Latviya: Livland, Kreis Riga, unter Juniperus am steilen sandabhang mit kiefernwald am No - ufer des jagel-sees O von Gesinde Sausing, April 1906 und '08, J. Mikutowicz (S-PA).

Bryum elegans is a species which grows mainly on limestone. It is apparently restricted to Europe. Many authors, including Dixon (1924), have followed Husnot (1884-'90) and placed it as a variety under B. capillare. Others have regarded it as of even lower status. Nyholm (1958), for instance, regarded it as merely an ecological form of B. capillare growing on limestone rocks. Certainly the most obvious character of B. elegans, its distinctive julaceous form, is not altogether constant; but, apart from its distinctive ecology, B. elegans also differs from B. capillare in other major characters. For example, the coarsely papillose rhizoids with characteristic papillae on them, which is one of the major distinguishing characters of B. elegans, are not present in any other species in the group. I have examined large numbers of specimens of B. elegans and the rhizoid characters have been proved to be constant. (Fig. 8).

Ochi (1957) reported the occurrence of B. elegans in Japan. I have not seen any Japanese material called 'elegans' and it may well have been misunderstood there. On many occasions I have seen in the herbarium sterile young or stunted specimens of B. capillare that have been identified as B. elegans. This may have been the case with the Japanese 'elegans'.

The important characters in which it differs from B. capillare are as follows:

B. elegans	B. capillare
Plant usually julaceous, leaves sometimes loosely twisted at the apex of stem when dry.	Plant not julaceous, leaves strongly spirally twisted around the stem when dry.

B. elegans	B. capillare
Rhizoids very coarsely papillose, papillae ± spine-like.	Rhizoids finely papillose, papillae ± blunt.
Tubers brown, very rare.	Tubers brown to reddish brown, abundant to scattered.
Leaves usually broadly ovate and strongly concave.	Leaves usually obovate-spathulate, plane or slightly concave.
Leaves always with strong excurrent nerve.	Leaves sometimes with non-excurrent nerve.
Leaf cells distinctly porose.	Leaf cells rarely porose.
Nerve of perigonial leaves excurrent.	Nerve of perigonial leaves non-excurrent.
Capsule usually small, 2-3 mm in length.	Capsule usually 3-5 mm in length.
Cells at the mouth of the capsule arranged in longitudinal rows.	Cells at the mouth of the capsule irregular in arrangement.
T.S. of seta shows definite layer of cells around the central strand.	T.S. of seta shows no definite layer of cells around the central strand.
Cells in the lid short, not in concentric layers.	Cells in the lid longer, arranged in concentric layers.

3. Bryum stirtonii Schimp., Syn. ed. 2:470.1876 (Figs.9.10)

B. capillare Hedw. var. carinthiacum B.S.G., Bryol. Eur. 4:131.369ζ 1839 (fasc. 6-9 Mon. 61.39ζ).

B. barbatum Wils. ex Hunt, Mem. Lit. Phil. Soc. Manchester 3(3):238.1868 (non Curtis ex With., 1801; non Vill. ex Brid., 1803) hom. illeg.

B. elegans Nees ex Brid. var. carinthiacum (B.S.G.) Breidl., Laubm. Steierm. 133.1891.

B. carinthiacum (B.S.G.) Kindb., Eur. N. Am. Bryin. 2:361.1897.

B. carinthiacum (B.S.G.) Kindb. ssp. spelugense Kindb., Eur. N. Am. Bryin. 2:361.1897.

B. tomentosum Kindb., Eur. N. Am. Bryin. 2:361.1897 (non Brid., 1826; non (Brid.)Sw., 1837; non(Joerg.) Hag., 1901) hom. illeg.

B. leptaleum Stirt., Ann. Scott. Nat. Hist. 12(46):113.1903.

B. capillare Hedw. ssp. spelugense (Kindb.) Par. cf. Limpr., Laubm. Deutschl. 3:779.1903.

B. tomentosulum Par., Ind. Bryol. ed. 2(1):264.1904.

B. obliviscionis Podp., Vestn. Klub. Prirod. Prost. 8:38.1906.

B. capillare Hedw. var. obliviscionis (Podp.) Podp., Act. Ac. Sc. Nat. Morav. 23:15.1951.

Plant densely or loosely tufted, green, sometimes tinged with red, soft, not julaceous, ½ - 4 cm high, repeatedly branched. Central strand of stem 20 - 40μ in diameter.

Rhizoids brown to reddish brown, finely papillose. Tubers absent.

Leaves loosely set, soft in texture, ovate, sometimes broadly ovate, concave, decurrent, little shrinking when dry, not twisted round the stem, rather incurved or closely appressed, sometimes spreading, ranging from 0.8 - 2 mm in length; nerve nonexcurrent, sometimes reaching at the apex,

mucronate to cuspidate, leaves around the perichaetial leaves usually with excurrent nerves; margin entire, slightly recurved, consisting of 1-2 rows of narrow cells; border not distinct. Basal cells ± rectangular, 15-25 x 56-67μ; upper cells ± hexagonal, 15-22 x 19-54μ; cell walls distinctly porose.

Dioecious. Perichaetial leaves narrow, lanceolate with cuspidate apex; nerve excurrent; female paraphyses not coloured. Perigonial leaves ovate, with excurrent and nonexcurrent nerves, ranging from 0.8 - 1.3 mm in length, concave; male paraphyses light orange. Antheridia in the axils of the perigonial leaves as well as at the tip of the branches.

Capsule small, subcylindrical, 2-3 mm in length (without lid), cernuous, not contracted below the mouth when dry, symmetrical, light brown to brown, mouth deep brown, glossy; neck distinctly short, shrinking when dry; exothecial cells at the mouth arranged ± in longitudinal rows, 2-3 rows of short cells at the mouth, cell walls equally thickened, cells below the mouth irregular in arrangement, 8 - 19μ in breadth, distinctly narrower than the lid cells. Lid orange or red, ± subhemispherical, with pointed tip; cells short, arranged in broken concentric layers, 9 - 30μ in breadth.

Spores 12.5 - 14 - 19 μ in diameter.

England: Rock crevices, The Bizzle, Cheviot (68), May 1950, R. Hall (as B. elegans) (B.B.S.).

Scotland: Ben Ledi, Perths. (87), 1864, Stirton (type of B. stirtonii Schimp.) (E). Ben Vorlich, Perths. (87), 1865, Schimper (S-PA). Ben Lawers, Perths. (88), c.fr., Aug.1908, J.B. Duncan (as B. capillare var. elegans). King's Seat near Killin (88), 1901, D. Haggart (type of B. leptaleum Stirt.) (GLAM). By the side of a boulder, Glas Tulaichean, Perths. (89), Sept.1964, J. Appleyard (as B. elegans) (B.B.S.).

Norway. Dovre: Kongsvold, 1000m., c.fr., July 1897, N.C. Kindberg (S-PA); Orkelho, Opdal, Sept. 1879, Kaurin (S-PA).

Sweden. Blekinge: On stone at Miean, Asarum, Sept.1917, Sigfrid Medelins (as B. elegans var. carinthiacum) (S-PA). Östergötland: Omberg, Aug.1920, E. Jaderholm (as B. elegans var. carinthiacum) (S-PA). Västergötland: On lime, Karlsfors, Lerdala, c.fr., Sept.1936, A. Hulphers (as B. elegans var. carinthiacum) (S-PA). Dalsland: Hill by Arr lake, Busterud, Froskog, Oct.1928, P.A. Larsson (as B. elegans var. carinthiacum) (S-PA). Södermanland: Holo, Oct.1927, C.A. Tarnlund (S-PA). Uppland: Svista, Balinge, June 1929, C.A. Tarnlund (S-PA). Västmanland: On lump of rock in Lake Halvars, Noren, July 1955, O. Ericsson (S-PA). Värmland: Valserudshojden, Nyed, Aug.1920, H.W. Arnell (as B. elegans) (S-PA). Dalarna: On granite rocks in pago, Ostbjorka, Boda, July 1897, H.W. Arnell (as B. elegans var. carinthiacum) (S-PA). Gästrikland: Par. Hille, Oppalagrund, c.fr., June 1899, H.W. Arnell (MICH). Medelpad: Aslo, Tyndero, June 1894, H.W. Arnell (as B. elegans var. carinthiacum) (S-PA). Härjedalen: South east end of Lack Rogen, Tannas, July 1928, T.G. Halle (S-PA). Jämtland: On soil under a rock, Rekvalen, Storlien, July 1922, S. Medelins (S-PA). Ångermanland: On block of stone, Hogsjo, July 1914, A. Arven (as B. elegans var. carinthiacum) (S-PA). Ångermanland: Halletorp, Sabra, c.fr., July 1906, H.W. Arnell (as B. elegans var. carinthiacum) (S-PA). Norrbotten: By the shore, Aug.1912, H.J. Moller (S-PA). Åsele Lappmark: Vilhelmina, June 1933, C. Malmstrom (S-PA). Lycksele Lappmark: Ronas, Tarna, July 1937, C. Malmstrom (S-PA). Lule Lappmark: In churchyard, Gellivare, July 1929, P.A. Larsson (as B. elegans var. carinthiacum) (S-PA).

Finland. Helsingfors: Sornas, c.fr., Oct.1866, S.O. Lindberg (as B. capillare var. carinthiacum) (S-PA).

Switzerland. Berghaus: Splügen, July 1888, N.C. Kindberg (type of B. carinthiacum (B.S.G.) Kindb. ssp. spelugense Kindb.) (S-PA); Findelen Alpe, c.fr., Sept.1901, Hermann (S-PA).

Czechoslovakia. Bohemia: M. Corcontici, ad declive sub Schüsselbauden, 1100 m, Sept.1900, Velenosky (BRNM); Moravia: Jesenik, Na prýstivých skalách u kotlině pri, 1200 m. 1904, Podpěra (type of B. obliviscionis Podp.) (S-PA); Slovakia: Tatra Magna; Bělské Tatry, in Summo monte Zadni'Jatky, 2000 m. Aug.1922. J. Podpěra (as B. capillare var. carinthiacum sub var. alpinum Podp.) (BRNM).

Bulgaria. Vitosa planina, Dragalevsko blato, July 1908, J. Podpěra (S-PA).

U.S.S.R. Latviya: Livland, Kreis Riga, unter Juniperus am steilen sandabhang mit kiefernwald am NO-Ufer des Jagel-sees O von Gesinde Sausing, May 1906 & '08, J. Mikutowicz (S-PA); Jenisei, Antsiferovo, Sibiria, c.fr., June 1876, H.W. Arnell (S-PA).

U.S.A. Michigan: Keweenaw Co., on ledge at Delaware, Sept.1936, W.C. Steere (as B. capillare) (MICH). Maine: near Columbia Falls, alt. 4000ft., May,Aug.1896, R.S. Williams (MICH). Alaska: Haencke Is., Disenchantment Bay, on boulders, July 1946, H. Person (as B. elegans) (MICH).

Canada. Alberta: Banff, Rocky Mountains, Mt. Hector, rocks, Aug.1890, J. Macoun (as B. tomentosulum) (S-PA); on earth at Hector, Rocky Mts. 1890, J. Macoun (type of B. tomentosum Kindb.) (CAN).

Bryum stirtonii is a plant of permanent habitats, usually growing on soil, rarely on limestone rocks, never growing epiphytically. It is distributed in Europe and in North America and seems to be more or less northern in its distribution.

B. stirtonii is often confused with B. elegans but can be readily distinguished from it by its decurrent leaves, by the short-necked capsule and by the rhizoids, which are not coarsely papillose. Dixon (1924) regarded B. stirtonii and B. barbatum Wils. as forms of B. elegans. Though B. stirtonii and B. barbatum have separate descriptions, in fact both are described from the same Ben Ledi material collected by Dr. Stirton.

B. capillare var. carinthiacum B.,S.&G. appears to be a synonym of B. stirtonii. I have not seen the type material of it, but a large number of herbarium specimens which have been identified as var. carinthiacum, and which have characters the same as those mentioned in its original description, are indistinguishable from B. stirtonii.

B. stirtonii is rarely fruiting; but it is not difficult to identify it sterile. A number of important characters by which it can be distinguished from B. elegans are given below:

B. stirtonii	B. elegans
Tubers not present.	Tubers present, brown, very rare.
Rhizoids finely papillose, papillae ± blunt.	Rhizoids very coarsely papillose, papillae ± spine-like.
Leaves decurrent.	Leaves nondecurrent.
Perigonial leaves with both excurrent and nonexcurrent nerves.	Perigonial leaves always with excurrent nerve.

B. stirtonii	B. elegans
Seta without any differentiated layer of cells around the central strand.	Seta with a differentiated layer of cells around the central strand.
Capsule with distinctly short neck.	Capsule with longer neck (as in B. capillare).
Capsule not contracted below the mouth when dry.	Capsule strongly contracted below the mouth when dry.
Capsule with 2-3 rows of short cells at the mouth.	Capsule with 5-6 rows of short cells at the mouth.
Cells below the mouth irregular in arrangement.	Cells below the mouth arranged in longitudinal rows.
Lid subhemispherical with acute tip.	Lid conical-apiculate with blunt tip.
Cells in the lid arranged in concentric layers.	Cells in the lid irregular in arrangement.

4. Bryum subelegans Kindb., Skand. Bladmfl. '176' 1903 (Fig. 11)

B. rechinii Card. ex Roth., Hedwigia 55:152. 1914.

B. capillare Hedw. var. rechinii (Card.) Podp., Consp. 351, 1954.

Plant loosely tufted, green, soft, 1 - 1½ cm high. Central strand of stem 25 - 125μ in diameter.

Rhizoids brown to reddish brown, finely papillose. Filamentous gemmae in the axils of leaves, coarsely papillose, 15 - 32μ in breadth; tubers not found.

Leaves loosely set, soft in texture, narrow ovate, shortly decurrent, ranging from 1.5 - 2 mm in length, concave, when dry not shrinking, closely appressed round the stem, not spirally twisted, mucronate with thick excurrent nerve, nerve shows ± equal thickness up to the apex; margin consisting of 1 - 2 rows of narrow elongated cells, strongly recurved; border not distinct. Basal cells ± rectangular, 15-28 x 32-80μ; upper cells rhomboid hexagonal, 15-28 x 28-57μ; cells distinctly porose.

Dioecious. Only female sex organs found. Perichaetial leaves short, broad, lanceolate, mucronate; margin recurved; inner leaves with nonexcurrent nerves; female paraphyses not coloured.

France. Savoi: Pralognan, 2500 m., 1907, Rechin (type of B. rechinii Card.) (S-PA).

Norway. Sör-Tröndelag: Kongsvold, July 1885, N.C. Kindberg (type of B. subelegans Kindb.) (S-PA).

Sweden. Bohuslän: Ytterby Sn., Sept.1934, H.E. Johansson (as B. elegans f. stemonophorum Podp.) (S-PA).

Kindberg's original description of B. subelegans is grossly inadequate for identification: "Blad (torra) vridna. Tufvor höga. Klippor r. Nge Kongsvold." Nevertheless it is sufficient to validate the name, which has priority over the more fully described B. rechinii Card.

B. subelegans is a plant often confused with B. elegans but it can be recognised very easily by the presence of its coarsely papillose filamentous axillary gemmae and by the characteristic broad-nerved leaves. It is an easily distinguished but much neglected species. Not much is known about the distribution of this species, but it seems to be restricted to Europe. I have recorded it from Norway, Sweden and France. I have not seen any fruit or male plant of it.

A number of characters in which it differs from B. elegans are given below:

B. subelegans	B. elegans
Plant loosely tufted, not julaceous.	Plant densely tufted, usually julaceous.
Axillary filamentous gemmae present.	Axillary filamentous gemmae absent.
Leaves shortly decurrent.	Leaves nondecurrent.
Nerve distinctly broad up to the apex of the leaf.	Nerve gradually narrowed upward.
Leaf margin strongly recurved.	Leaf margin not recurved.
Margins of perichaetial leaves recurved.	Margins of perichaetial leaves not recurved.

5. Bryum flaccidum Brid., Bryol. Univ. 1:667.1826 (Figs.12,13)

B. capillare Hedw. var. flaccidum (Brid.) B.S.G., Bryol. Eur. 4:130. 369δ. 1839 (fasc. 6-9 Mon. 60. 39δ).

Plant loosely tufted, repeatedly branched, light green, soft, 1 - 4 cm high. Central strand of stem 30 - 90μ in diameter.

Rhizoids light brown to brown, finely papillose. Tubers and filamentous gemmae present. Filamentous gemmae axillary, finely papillose, protonema-like, cells with chloroplasts when young, brown at maturity, cells in the filaments 15 - 35μ in breadth, filaments variable in length, branched or unbranched. Tubers round, brown, with nonprotuberant cells, 65 - 120μ in diameter, scattered, on long rhizoids.

Leaves loosely tufted, light green, when dry not much shrinking, twisted round themselves and not around the stem, rarely loosely twisted around the stem, sometimes spreading, longly and narrowly ovate, 1.4 - 4.0 mm in length, cuspidate to longly cuspidate, longly or shortly decurrent; nerve usually excurrent, sometimes vanishing below the summit, usually not coloured, sometimes brown or reddish brown; border consisting of 2 - 3 rows of narrow elongated cells, yellowish in the older leaves; margin entire, wavy, rarely toothed, slightly recurved. Basal cells rectangular, very variable in size, 16-25 x 32-113μ, upper cells ± hexagonal, 12-19 x 22-69μ, rarely porose.

Dioecious. Perichaetial leaves lanceolate, cuspidate, margin not recurved; nerve excurrent; female paraphyses not coloured. Perigonial leaves smaller than the vegetative leaves, ranging from 1.0 - 1.4 mm in length, concave, ovate; nerve excurrent; male paraphyses orange. Antheridia in the axils of the perigonial leaves as well as at the tip of

the branches.

Seta 2 - 3 cm long, lower portion brown to deep brown, upper portion light brown; without differentiated layer of cells around the central strand.

Capsule subcylindrical, 2 - 3 mm in length (without lid), with a distinct neck, cernuous, not contracted below the mouth when dry, symmetrical, pale brown to reddish brown, mouth brown to reddish brown, glossy; neck not distinctly shrunken when dry; exothecial cells at the mouth forming 5 - 7 layers of short cells, uppermost layer being transversely elongated, not in longitudinal rows, cells below the mouth 15 - 32μ in breadth, not in longitudinal rows. Lid light brown to brown, subconical with blunt tip, cells arranged in concentric layers, 24 - 38μ in breadth.

Spores 9.5 - 12.5μ in diameter.

England: On old Elder near Maiden Bradley, Wiltshire (8), Nov.1970, J. Appleyard. On stump at road-side on north side of Wheatham Hill, near Liss, Hampshire (12), July 1970, A.C. Crundwell (GL). With B. capillare on Elder in woodland, north Marden Down, near South Harting, Sussex (13), Dec.1971, A.C. Crundwell, F.Rose & E.C. Wallace (ACC). On Ash trunk in a hedge which had been laid, Lewes, Sussex (14), Jan.1905, W.E. Nicholson (as B. capillare var. rosulatum Mitt.) (CGE). About the roots of Beech, steep woodland bank, Buxton, Kent (16), Jan.1971, A.G. Side. On bough of Elder, Dry Hill near Sevenoaks, Kent (16), Mar.1958, (with B. capillare) A.G. Side. On Elder near Cobham, Surrey (17), Oct.1909, L.J. Cocks (as B. capillare) (CGE). On decaying tree trunk in Ash plantation, Cavenham Heath, Suffolk (26), Nov.1970, H.L.K. Whitehouse (CGE). On decaying tree trunks, Madingley Wood, Cambridgeshire (29), Nov.1957, H.L.K. Whitehouse

(as B. capillare) (CGE). On rotten log, boggy wood by Hildersham church, Cambridgeshire (29), April 1956, C.C. Townsend (as B. capillare) (Whitehouse). On stump of Fraxinus excelsior, Shadbury Lane, Bassingbourn, Cambridgeshire (29), Nov.1962, P.D. Sell (as B. capillare) (CGE). On tree boughs, Woodwalton Fen, Huntingdonshire (31), Dec.1959, B. Ing (as B. capillare) (CGE). Log of dead wood, near Llanfyllyn, Montgomery (47), June 1971, A.G. Side. On limestone, Aller Gill fluorspar mine near Stanhope, Durham (66), July 1970, H. McAllister.

Scotland: On Acer pseudoplatanus & Ulmus glabra near a pool, grounds of Portmore House, 5 miles N. of Peebles (78), Sept.1971, C.C. Townsend. On thin soil overlying acid rock, Black Andrew Wood, 7 miles SW of Galashiels, Selkirkshire (79), Aug.1971, C.C. Townsend. On bole of Sycamore in woodland, Roslin, Midlothian (83), Sept.1971, A.C. Crundwell.

Norway. Dovre: Kongsvold, 1200 m., July 1884, N.C. Kindberg (as B. ferchelii) (S-PA).

Sweden. Skåne: On edge of stone table in garden, Nordana gard, Broby, Aug.1970, A.C. Crundwell (GL). Småland: Madesjö, Oct.1912, S. Medelins (S-PA). Gotland: North of Hoburgen, Sundre, June 1908, K. Johansson (as B. carinthiacum) (S-PA). Östergötland: Linkoping, July 1878, N.C. Kindberg (as B. speirophyllum) (S-PA). Västergötland: In botanic garden, Patradalum, Skara, July 1893, H.W. Arnell (as B. elegans var. rosulatum) (S-PA). Göteborg: Sept.1912, C. Hjarne (S-PA). Uppland: Churchyard wall, Sanga, Sept.1963, E.V. Krusenstjerna (S-PA). Västmanland: Arboga, Sept.1918, C.A. Tarnlund (S-PA). Värmland: Ranneberget, Aug.1936, A. Hulphers (S-PA). Dalarna: In loco umbroso

supra Ovan myra, ad terram, Boda, Aug.1896, H.W. Arnell (as B. elegans var. ferchelii) (S-PA). Jämtland: Bagede, Frostviken, Aug.1925, R. Florin (S-PA); Earthy limestone rocks in felled Spruce forest 4 km N. of Lit, Aug.1966, Elsa Nyholm & A.C. Crundwell (GL).

West Germany. Hameln auf Weser, c.fr., 1877, Braun (S-PA). Hessen, 240 m. Nov.1895 Roth (as B. triste) (S-PA).

Austria. Lölling, Carinthia, c.fr., July 1897, W.E. Nicholson (as B. obconicum) (CGE).

Hungary. Komarom: In silvis ad pedem sept. montis kistekehegy in valle Bikol prope SUTTO, Esztergom, June 1938, A. Boros (S-PA). Borsod - Abauj: Ad truncos putr. in faginetis vallis ablakoskovolgy prope pag. NAGYVISNYO, Sept.1948, A. Boros (S-PA). Comit Fejér: in dumetis supra vallem sub Pusztakápolna, versus Gánt, March 1936, A. Boros (as B. capillare f. filamentosum Podp.) (BRNM).

Czechoslovakia. Moravia: Kotlina na Jeseniku, July 1907, J. Podpěra (as B. capillare var. ustulatum Roth.) (BRNM).

Poland. Krakow: Montes Tatri Alti, vallis Dolina Roztoki. Ad basim arborum (Sambucus recemosa et Sorbus aucuparia) sub cataractum Wodogrzmoty Mickiewicza dictum, May 1957, S. Lisowski (S-PA); Montes Babia Gora, Ad corticem fagi prope pratum Czarna Hala, Sept.1957, T. Wojterski (S-PA).

Turkey. Izmir: On rock in pine forest south east of the village Bozdag, 1280 m., April 1971, Elsa Nyholm & A.C. Crundwell (GL).

U.S.A. California: Placer Co., Stanford Rock along Highway 89, west shore of Lake Tahoe, June 1947, L.F. Koch (as B. capillare) (MICH). Michigan: Mackinac Co., Caffey Corner, limestone outcrop, Aug.1968, H. Crum (as B. capillare) (MICH); Otsego Co., Hardwoods (Beech woods), 1 mi. S. of junction of Gibbs and Marquardt roads, Aug.1969, H. Crum (as B. capillare) (MICH); Delta Co., on dry soil, crest of limestone ledge in hardwood forest at center of Summer Island, July 1968, N.G. Miller (as B. capillare) (MICH). New Hampshire: Grafton Co., on mud in brook; submerged nearly all the time, Sugar-Woods Path, Brighthollow, Grafton, alt. 960ft. Oct.1949, E.P. Hutchinson (as B. capillare) (GL).

Canada. British Columbia: rocks, June 1890, J. Macoun (S-PA); Rocky Mountains, Devils Lake, Aug.1891, J. Macoun (as B. capillare) (S-PA). Ontario: Elgin Co., on glacial boulders in moist woods, July 1969, W.M. Stewart (as B. capillare) (MICH).

B. flaccidum is a plant of varied habitats. In the British Isles it is mainly epiphytic, growing on tree trunks and tree boughs, on rotten and decaying logs, very rarely on soil; in Europe and in North America it grows both on soil and on tree trunks, rarely on acid rocks. I have recorded it only from Europe and North America. I have not seen any specimen of it from Asia, but I have examined one specimen from Japan identified as B. capillare var. rubrolimbatum (Broth) Bartr. (Pref. Kyoto: On rock, Nakagawa, Bodainotaki, ca. 200 m. alt., c.fr., Nov.1971, T. Kodama, no.42279 (GL)). It did not bear any tubers, but some of the plants were found to bear axillary filamentous gemmae like those of B. flaccidum. Its leaves were nondecurrent; the spores were coarsely papillose and showed a wide range of variation in size (from 12 - 28μ in

diameter). The specimen is not a typical flaccidum and also has no bearing on the taxonomic status or position of B. rubrolimbatum. It may well be a result of hybridization, but it is difficult to reach any conclusion on the basis of a single gathering. It suggests that B. flaccidum may occur in Japan, for such individuals might be the result of hybridization between B. flaccidum and B. capillare. On the other hand, if B. flaccidum and B. capillare do form hybrids it is odd that no intermediates between them have been seen from Europe or North America. Fruit is very rare in B. flaccidum; only three fruiting gatherings being known to me.

B. flaccidum is closely related to B. capillare and has been regarded by most authors as a variety of it; but it can be readily distinguished from B. capillare by its filamentous axillary gemmae, by the size of its tubers and by its decurrent leaves. I have seen the type specimen of B. flaccidum Brid. (B) collected by Balbis. Bridel published it from Hispaniola and on the specimen sheet it was hand-written by him, but I think he made a mistake about the name of the place because, according to present information, Hispaniola is outside the geographical range of B. flaccidum, and there is a strong possibility that it was collected from Hispania (Spain). Balbis certainly did collect in southern Europe; there are many of his specimens from Sardinia in the Glasgow University herbarium. The important distinguishing features of B. flaccidum, as compared with B. capillare, are as follows:

B. flaccidum	B. capillare
Filamentous axillary gemmae present.	Filamentous axillary gemmae absent.
Tubers brown, small.	Tubers brown to reddish brown, larger.

B. flaccidum	B. capillare
Leaves not strongly twisted round the stem when dry.	Leaves usually strongly twisted round the stem when dry.
Leaves decurrent.	Leaves nondecurrent.
Margin of the perichaetial leaves not recurved.	Margin of the perichaetial leaves recurved.
Neck of the capsule not distinctly shrunken when dry.	Neck distinctly shrunken when dry.
Uppermost layer of cells at mouth of capsule transversely elongated.	Mouth cells not transversely elongated.
Lid subconical with blunt tip.	Lid conical-apiculate.
Spores 9.5 - 12.5μ in diameter.	Spores 12 - 15μ in diameter.

6. Bryum laevifilum Syed, n.sp. (Figs.14-16)

Planta laxe caespitosa, repetite ramosa, dilute viridis, mollis, ½ - 2 cm alta. Filum centrale caulis 25 - 63μ diam.

Rhizoidea pallida vel dilute brunnea, haud papillosa. Tubera et gemmae filamentosae adsunt. Gemmae filamentosae axillariae, ± laeves; cellulae juvenes chloroplastis, ad maturitem brunneae; cellulae filamentorum 25 - 35μ latae; filum brevium, ramosum vel non-ramosum. Tubera pauca, sphaerica, brunnea, cellulis non protuberantibus, 65 - 120μ diam, in rhizoidis longis.

Folia laxe disposita, dilute virides, in sicco paulo contracta, torta sed non circum caulem, aliquando sparsa, breves, 1.5 - 2 mm longa, ovata, mucronata ad cuspidata, non decurrentes, costa nonexcurrens, plerumque incolorata, interdum brunneola vel rufo-brunneola; margo plerumque non distincta, raro in foliis veteribus distincta; margo integra, sinuata, raro subtiliter denticulata, non recurvata, cellulis elongatis angustis serierum 1-2 dispositis.

Cellulae basales ± rectangulares, 12 ± 22μ x 25 x 94μ, cellulae superae ± hexagonae, 16 ± 19μ x 32 ± 47μ, raro porosae.

Dioica. Folia perichaetiales angusta, lanceolata, cuspidata; costa excurrens; margo non recurvata; paraphyses incolorata. Folia perigoniales pusilliores quam folia vegetativa, 0.8 - 1.25 cm longa, ovata, concava; costa non excurrens; paraphyses aurantiacae. Antheridia in axillis foliorum perigoniorum et ad apices ramorum disposita.

Seta 1.5 - 2 cm longa, infra brunnea, insuper dilute brunnea. Cellulae circum filum centralem non differentiatae.

Capsula subcylindrica, 1.5 - 2 mm longa (sine operculo), pallido-brunnea ad rufo brunnea; orificium leviter obliquum, brunneum ad rufo-brunneum, nitidum, cellulae orificium breves, 2-4 in seriebus dispositae,

cellulae exothecii 15 - 32μ latae, nec in seriebus longitudinalibus dispositae; colum in sicco non contractum.

Operculum brunneum ad brunneolo aurantiacum, subhemisphaericum, apice acuto, cellulae in stratis concentricis, 15 - 25μ latae.

Sporae 9.5 - 10 - 12.5 - 15.5μ diam.

England: On Elder branch by stream, Matlock, Derby (5), April 1972, R. Richter. On branch of Elm in hedge at road-side, two miles north west of Bentley, Hampshire (12), Mar.1970, A.C. Crundwell (GL). Base of Ash tree, wood near Wittersham, Kent (15), May 1972, A.G. Side. On Elm near Down, Kent (16), July 1920, St. J. Marriot (as B. capillare var. flaccidum) (CGE). On tree bark by the side of the Fen road, Bassingbourn (29), Mar.1952, P.D. Sell (as B. capillare) (CGE). On base of tree, Wandlebury, Gog Magog Hills, Cambridgeshire (29), Oct.1962, P.D. Sell (as B. capillare) (CGE). On Elder, Dams Spinney, Stoughton, Leicestershire (55), Jan.1972, F.A. Sowter.

Scotland: On trunk of Sycamore in estate on north side of Habbies Howe, Midlothian (83), Sept.1971, A.C. Crundwell.

Sweden. Småland: Angsholm, Gränna, April 1912, A. Arven (as B. capillare var. flaccidum) (S-PA). Östergötland: Sturefors, 1881, N.C. Kindberg (as B. speirophyllum) (S-PA). Västergötland: On tree trunk in botanic garden, July 1893, H.W. Arnell (as B. elegans var. rosulatum) (S-PA). Göteborg: Sept. 1912, Carl Hjarne (as B. capillare var. flaccidum) (S-PA). Södermanland: Near the castle, Tyreso, Aug.1937, C.A. Tarnlund (B. capillare var. flaccidum) (S-PA). Västmanland: By the mine, Sala, Oct.1922, C.A. Tarnlund (S-PA).

Switzerland. Vaud: Diablerets, July 1901, W.E. Nicholson (OXF). Ticino: Lugano, c.fr., July 1895, N.C. Kindberg (as B. torquescens) (S-PA). Uri: Goschenen, Aug.1895, N.C. Kindberg (as B. carinthiacum) (S-PA).

Austria. Ost Tirol: Innervillegraten, July 1889, H. Gander (S-PA). Baden, Wien, c.fr., June 1860, J. Juratzka (as B. capillare var. carinthiacum) (S-PA).

Czechoslovakia. Moravia: Talč, 700 m.s.m., Aug.1942, J. Podpěra (as B. capillare var. pulvinatum Warnst.) (BRNM).

Italy. Como: Monte Generoso, July 1895, J. Röll (as B. capillare var. carinthiacum) (S-PA).

Hungary. Borsod: Bukkfennterseg; Ad truncos putr. in faginetis "Bolhas" ad JAVORKUT, c.fr. July 1948, A. Boros (type of B. laevifilum Syed) (S-PA).

U.S.S.R. Tskhenis Tskali, Laschketi pr.fl., Svanethia, Caucasus, c.fr., June 1877, A.H. & V.F. Brotherus (as B. capillare) (S-PA).

U.S.A. Arizona: Chiricahua Mts. Cochise Co., on soil between rocks in Douglas Fir woods, 9000 ft., c.fr., Aug.1948, W.S. Phillips (as B. capillare) (MICH). Montana: Flathead Co., Glacier National Park, trail to Grinnell Lake, Aug.1965, R.R. Ireland (as B. capillare) (MICH). Michigan: Galesburg, base of trees, Jan.1932, H.R. Becker (as B. capillare) (MICH); Charlevoix Co., Chandler Community Hall at Chandler Hill and Major roads, July 1969, H. Crum (MICH); Mackinac Co., Little Dollar Lake, Aug. 1968, H. Crum (as B. capillare) (MICH); Delta Co., in shade at base of

Thuja, limestone ledges and boulders around Summer Sci. Camp, Summer Island, July 1968, N.G. Miller (as B. capillare) (MICH).

Canada. British Columbia: Wet soil in rock crevice, along the Sikanni river (near mile 116) above Fort St. John, on cliffs and bluffs on south side of river, June 1943, D.S. Correll (as B. capillare) (MICH).

Bryum laevifilum grows in habitats similar to those of B. flaccidum Brid. The two species are very closely related and are difficult to distinguish in the field, but microscopic examination clearly separates it from B. flaccidum by its smooth axillary filamentous gemmae and nondecurrent leaves. Both species have similar geographical distributions. Fruit is very rare in B. laevifilum. I have seen only four gatherings of fruiting specimens of it.

I have seen one packet of B. laevifilum from Podpera's herbarium which is identified as B. capillare var. pulvinatum Warnst., but as it was not a type, I could not depend on it for a correct epithet for B. laevifilum. I have not seen any type material similar to B. laevifilum and therefore described it as a new species. A number of important characters in which it differs from B. flaccidum are given below:

B. laevifilum	B. flaccidum
Filamentous axillary gemmae smooth.	Filamentous axillary gemmae finely papillose.
Rhizoids smooth.	Rhizoids finely papillose.
Leaves nondecurrent.	Leaves decurrent.

B. laevifilum	B. flaccidum
Perigonial leaves with nonexcurrent nerves.	Perigonial leaves with excurrent nerves.
Capsule 1.5 - 2 mm in length.	Capsule 2-3 mm in length.
Capsule slightly oblique at the mouth.	Capsule symmetrical.
Cells at the mouth of the capsule forming 2-4 layers of short cells.	Cells at the mouth of the capsule forming 5-7 layers of short cells.
Lid subhemispherical with acute tip.	Lid subconical with blunt tip.
Cells in the lid narrow, 15-25μ in breadth.	Cells in the lid broader, 24-38μ in breadth.

7. Bryum pseudocapillare Besch., Ann.Sc.Nat.Bot. ser. 6, 3:205.1876. (Figs.17,18,37)

B. sawyeri Ren. et Card., Rev. Bryol. 15:71.1888.

Plant loosely tufted, branched or unbranched, green, soft, ½ - 1¼ cm high. Central strand of stem 25 - 65μ in diameter.

Rhizoids pale brown to brown, finely papillose. Tubers and filamentous gemmae present. Filamentous gemmae axillary, reddish or reddish brown, ± smooth, 20 - 25μ in breadth, sometimes absent. Tubers orange or pinkish orange, round, 200 - 270μ in diameter or oval, 150-260 x 350-465μ.

Leaves loosely set, soft in texture, ovate or spathulate, ranging from 1-2 mm in length, not concave, when dry not much shrinking, usually not spirally twisted, rather spreading, cuspidate with nonexcurrent or excurrent nerve; margin finely toothed or entire, not recurved, consisting of 1-2 rows of narrow elongated cells; border not distinct. Basal cells ± rectangular, 15-24 x 21-60μ; upper cells rhomboid hexagonal, thin walled, 12-24 x 30-54μ; cell walls not porose.

Dioecious. Perichaetial leaves short, narrow, lanceolate with mucronate or cuspidate apex; outer leaves with excurrent nerve, inner leaves with nonexcurrent nerve; female paraphyses not coloured. Perigonial leaves much smaller than the vegetative leaves, ranging from 0.6 - 0.9 mm in length, ovate, concave; nerve excurrent; male paraphyses very few in number, light orange or not coloured. Two types of male heads present:

1. Antheridia at the tip of branch.
2. Antheridia also in the axils of perigonial leaves.

Seta 1.5 - 2 cm long, brown to deep brown at the base, light brown at the upper portion; seta without differentiated layer of cells around the central strand.

Capsule subcylindrical, 2 - 3.5 mm in length, with a distinct neck, cernuous, slightly contracted below the mouth when dry, symmetrical, pale brown to brown, mouth reddish brown, neck not distinctly shrunken when dry; exothecial cells at the mouth forming 4-5 layers of short cells, the uppermost single layer being transversely elongated; cells below the mouth 15 - 30μ in breadth, not arranged in longitudinal rows; lid reddish brown, subhemispherical, cells 15 - 30μ in breadth, not in distinct concentric layers.

Spores 9 - 12.5μ in diameter.

Lesser Antilles. St. Barthélemy: Gris - Gris, morne de petite saline, Feb.1956, C. Le Gallo (as B. capillare) (MICH). Martinique: c.fr., Plee (type of B. pseudocapillare Besch.) (BM).

Puerto Rico. On moist clay along trail from Maricao south to Maricao Insular Forest, Dec.1939, W.C. Steere (as B. capillare) (MICH). In moist pocket in limestone, trail to caves near Agnas Buenas, Nov.1939, W.C. Steere (as B. capillare) (MICH).

Cuba. Loma del Gate, 1000 m., c.fr., Dec.1933, Herb. I. Theriot, n. 11865 (S-PA).

Honduras. Comayagua, on hummocks in dried swamp, vicinity of Siguatepeque, about 1050 m., c.fr., Mar.1947, Paul C. Standley & Jaime Chacon P. (as B. capillare) (MICH).

Guatemala. Izabal, at base of coconut tree, along sea shore around Punta Palma, across bay from Puerto Barrios, alt. 0-1 m., April 1940, J.A. Steyermark (as B. capillare) (MICH).

Mexico. Veracruz, on partly burned log along the side of road cut through second growth forest, Ejido de Manzanares, 1-4 km. north west of Campo Experimental de Hule, El Palmar, Zongolica, c.fr., Aug.1943, J.V. Santos (as B. capillare) (MICH).

U.S.A. Florida: Collier Co., Deep Lake, old rotted log above water, c.fr., Mar.1940, W.S. Phillips (as B. capillare) (MICH); Manatee Co., on soil and decaying wood, common in moist places, c.fr., Mar.-April 1926, A.J. Grout (as B. capillare) (MICH); Polk Co., high hammock, vicinity of Lakeland, c.fr., Mar.1931, James B. McFarlin (as B. capillare) (MICH); Orange Co., on rotten logs in woods near Sanford, c.fr., July-Aug.1903, S. Rapp (as B. sawyeri) (MICH); Seminole Co., on clay banks, Colby Farm, near Sanford, Mar.1905, S. Rapp (as B. floridanum) (MICH); St. Johns Co., road 14A, three miles S. of Crescent Beach, Oct.1941, H. Kurz (as B. capillare) (MICH); Duval Co., Little Talbot Island State Park, on downed Sabal trunk in open coastal forest, c.fr., Mar.1970, Dana Griffin, no.1801 (as B. capillare) (GL); Madison Co., Withlacooche River, Nov.1939, R.O. Schornherst (as B. capillare) (MICH); Leon Co., Loon Lake, on burnt stump, c.fr., April 1939, R.O. Schornherst (as B. capillare) (MICH). Beauclerc, sur bois pourri, 1887, Sawyer, no.61 (Topotype of B. sawyeri Ren. et Card.) (BM).

Louisiana: New Orleans, Lake Catherine, c.fr., Feb.1926, G.B. Kiser, R.D. Srihla (MICH); on wood work of bridge in Bayou Sauvage on old Gentilly road near St. Ferdinand Avenue, Nov.1948, Francis Drouet and Perey Viosca Jr. (as B. capillare) (MICH).

Georgia: Franklin Co., on sandy soil, Indian Pass lagoon, c.fr., April 1931, R.O. Schornherst (MICH).

Maryland: Prince Georges Co., border of spring under Oak roots, barnyard on Kluckhuhn road, plot 5441, Jan.1947, E.C. Leonard (as B. capillare) (MICH).

Bryum pseudocapillare is a plant growing on burnt or rotten logs, clay or sandy soil, rarely on limestone rocks. B. pseudocapillare is restricted to the southern parts of North America. It is more widely known by its synonym B. sawyeri Ren. et Card. B. pseudocapillare can be confused with B. laevifilum; but apart from its distinct geographical distribution, it can be readily distinguished from B. laevifilum by the colour and size of its tubers. The important characters by which it differs from B. laevifilum are as follows:

B. pseudocapillare	B. laevifilum
Distribution restricted to southern part of North America.	Distributed in Europe as well as in North America.
Tubers big, bright orange to pinkish orange.	Tubers small, brown.
Rhizoids finely papillose.	Rhizoids smooth.
Leaf cells not porose.	Leaf cells rarely porose.
Perigonial leaves with excurrent nerves.	Perigonial leaves with nonexcurrent nerves.

B. pseudocapillare	B. laevifilum
Two types of antheridial heads present: 1. antheridia terminal. 2. antheridia also in the axils of perigonial leaves.	Antheridia in the axils of perigonial leaves as well as at the tip of branch.
Capsule 2-3 mm in length.	Capsule 1.5-2 mm in length.
Capsule symmetrical.	Capsule slightly oblique at mouth.
Cells in the lid not in distinct concentric layers.	Cells in the lid arranged in concentric layers.

8. Bryum erythroloma (Kindb.) Syed, comb. nov. (Figs.19-21,36)

B. capillare Hedw. ssp. erythroloma Kindb., Eur. N. Am. Bryin. 2:358. 1897.

Plant densely or loosely tufted, green tinged with maroon, sometimes maroon, soft 1 - 2½ cm high, repeatedly branched. Central strand of stem 22 - 48μ in diameter.

Rhizoids brown to reddish brown, finely papillose. Tubers reddish orange to maroon, on long rhizoids, never axillary, (orange at young, maroon at maturity), scattered, round, 190 - 266μ in diameter or oval, 180-266 x 210-340μ.

Leaves loosely or densely set, soft in texture, widely ovate or obovate-spathulate, plane or slightly concave, decurrent, when dry not much shrinking, spirally twisted round the stem, sometimes closely appressed or spreading, ranging from 1.5 - 3 mm in length, mucronate to cuspidate; with both excurrent and nonexcurrent nerve in the same plant, nerve maroon, sometimes reddish brown, rarely pale brown; upper margin distinctly toothed; border distinct, consisting of 3 - 4 rows of narrow elongated cells, in older leaves 5 - 7 rows of cells distinctly thickened, usually coloured yellow. Basal cells $\pm$ rectangular, 18-31 x 37-63μ; upper cells $\pm$ hexagonal, 15-25 x 31-54μ, rarely porose.

Dioecious. Perichaetial leaves light maroon with cuspidate or piliferous apex, margin recurved; nerve nonexcurrent; female paraphyses maroon at the base, orange at the upper portion. Perigonial leaves much smaller than the vegetative leaves, ranging from 0.5 - 1.3 mm in length, broadly ovate, concave, outer leaves with toothed margin, inner leaves entire, orange; nerve nonexcurrent; male paraphyses bright orange. Antheridia in the axils of perigonial leaves as well as at the tip of the

branches.

Seta 2 - 3.5 cm long, lower portion brown to deep reddish brown, upper portion light brown; seta without differentiated layer of cells around the central strand.

Capsule subcylindrical, with a distinct neck, 2.5 - 4 mm in length (without lid), cernuous, slightly contracted below the mouth when dry, symmetrical, light brown to reddish brown, mouth deep brown to reddish brown, glossy; neck shrinking when dry; exothecial cells at the mouth of only one layer of transversely elongated cells and the rest 4 - 5 layers of short hexagonal cells, cells below the mouth not in longitudinal rows, 15 - 47μ in breadth. Lid brown to deep brown, conical apiculate, cells narrow, 9.5 - 25 μ in breadth, not in concentric layers. Inner peristome teeth with very long apendiculate apex (unlike B. capillare).

Spores 9.5 - 12 μ in diameter.

Canada. British Columbia, Vancouver Island: Victoria; on rocks, c.fr., June 1908, J. Macoun (S-PA); on rocks, Sea's Farm, June 1908, J. Macoun (S-PA); on rocks, c.fr., April 1887, J. Macoun (as B. speirophyllum) (S-PA); Cedar Hill, c.fr., April 1887, J. Macoun (CAN); On earth, c.fr., May 1887, J. Macoun (as B. speirophyllum) (S-PA).

U.S.A. Oregon: Oregon boundary commission, c.fr., 1858-'59, Dr. Lyall (S-PA).

B. erythroloma grows on rocks and soil and never in epiphytic habitats. It is restricted to North America. Most authors have regarded Bryum

erythroloma as a subspecies under B. capillare to which it is closely related. Apart from its restricted distribution it can readily be distinguished by the colour of its tubers and by its decurrent leaves. I have not seen the exact type of it, but have a specimen collected by John Macoun before its publication which can I think be regarded as authentic.

The important characters of B. erythroloma compared with those of B. capillare are as follows:

B. erythroloma	B. capillare
Distribution restricted to North America.	Widely distributed all over the world.
Tubers orange to maroon.	Tubers brown to reddish brown.
Leaves decurrent.	Leaves nondecurrent.
Leaves not much shrinking when dry.	Leaves much shrinking when dry.
Leaves mucronate to cuspidate.	Leaves cuspidate to longly piliferous.
Uppermost layer of exothecial cells at mouth of capsule transversely elongated.	Exothecial cells at mouth not forming any layer of transversely elongated cells.
Exothecial cells 15 - 47μ in breadth.	Exothecial cells 15 - 34μ in breadth.
Cells in the lid not in concentric layers.	Cells in the lid arranged in concentric layers.

B. erythroloma

Inner peristome teeth with very long apendiculate apex.

Spores 9.5 - 12μ in diameter.

B. capillare

Inner peristome teeth not with long apex.

Spores 12 - 15μ in diameter.

9. Bryum albo-limbatum (Hamp.et C.Muell.) Jaeg.,

Ber. S. Gall. Naturw. Ges. 1873-74:191.1875 (Figs.22-24)

Rhodobryum albo-limbatum Hamp., Linnaea 36:517,299.1870.

B. pusillum Broth., Oefv. Finsk. Vet. Soc. Foerh. 33:99.1890 (non Dicks. ex With., 1801; non Schultz ex Hassk., 1851; non C. Muell., 1900) hom. illeg.

Plant loosely tufted, deep green or maroon, ½ - 1½ cm high. Central strand of stem 25 - 150μ in diameter.

Rhizoids brown, finely papillose. Tubers and filamentous gemmae present. Filamentous gemmae axillary, light brown, papillose, branched or unbranched, 15 - 35μ in breadth. Tubers on long rhizoids, orange, with nonprotuberant cells, round, 250 - 400μ in diameter, or oval, 180-400 x 260-500μ.

Leaves loosely or densely set, usually with tufted leaves at the branch apex, soft in texture, wide, obovate-spathulate, sometimes ovate, plane, not much shrinking when dry, slightly twisted or spreading, ranging from 1.5 - 3.5 mm in length; mucronate to cuspidate; nerve apex usually tinged with brown, reddish brown or maroon, sometimes not coloured, strongly excurrent; margin distinctly and coarsely toothed in more than half the length of the leaf, toothing distinct even in dry condition, sometimes not distinct, slightly recurved; border distinct, consisting of 2 - 4 rows of narrow elongated cells, usually not coloured. Basal cells broadly rectangular, 15-22 x 47-110μ; distinctly porose; upper cells rhomboid hexagonal, short and narrow, 12-19 x 32-63μ, rarely porose, thin walled.

Dioecious. Perichaetial leaves narrow, lanceolate, cuspidate, margin coarsely toothed; nerve excurrent; female paraphyses orange. Perigonial leaves much smaller than the vegetative leaves,

ranging from 0.9 - 1.1 mm in length, ovate, concave, orange; nerve excurrent; male paraphyses bright orange. Antheridia in the axils of perigonial leaves as well as at the tip of the branches.

Seta 1.5 - 2.5 cm long, lower portion brown to deep brown, upper portion light brown; seta without differentiated layer of cells around the central strand.

Capsule subcylindrical, 2 - 4 mm in length (without lid), with a distinct neck, cernuous, slightly contracted below the mouth when dry, symmetrical, light brown to brown, mouth brown to deep brown, glossy; neck not distinctly shrunken when dry; exothecial cells at the mouth irregular in shape (not distinctly hexagonal), 6 rows of short cells with thick transverse walls, longitudinal walls thin, cells below the mouth very narrow, 6-9 - 12.5 - 25μ in breadth. Lid brown to deep brown, conical acuminate, cells very narrow mixed with few broad cells, 6 - 9 - 12.5 - 18.5μ in breadth, in concentric layers.

Spores 12.5 - 15.75μ in diameter.

Australia. West Australia: Porongorup, c.fr., Oct.1867, F. Müller (type of B. albo-limbatum Hamp.) (BM).

South Australia: Wet rocks, Hindmarsh Falls, Mount Lofty Range, c.fr., Aug.1956, H.J.M. Bowen (C.C. Townsend).

Queensland: Helidon, ubi ad corticem arborum, Dec.1888, no.9, C. Wild (type of B. pusillum Broth.) (H).

Bryum albo-limbatum is known only from Australia. I have been able to examine too few specimens of it to be able to generalise further about its distribution.

Ochi (1970) regarded it as a synonym of B. capillare. It may be confused with B. capillare but can be easily distinguished by the colour and size of its tubers, by the presence of filamentous axillary gemmae and by the coarsely toothed margins of the perichaetial leaves.

B. pusillum Broth. is a synonym of B. albo-limbatum. I have seen the type material of B. pusillum; it varies from B. albo-limbatum only in the less coarsely toothed leaf margins, but all other characters are similar. Though the toothing in the margins varies in vegetative leaves, the perichaetial leaves always have toothed margins, while in B. capillare they are always smooth.

The important characters of B. albo-limbatum, compared with those of B. capillare, are as follows:

B. albo-limbatum	B. capillare
Distribution restricted to Australia.	Widely distributed all over the world.
Filamentous axillary gemmae present.	Filamentous axillary gemmae absent.
Tubers big, orange.	Tubers smaller, brown to reddish brown.
Leaves not much shrinking when dry.	Leaves much shrinking when dry.
Leaf margin usually very coarsely toothed.	Leaf margin finely toothed or entire.
Perichaetial leaves cuspidate, margin coarsely toothed.	Perichaetial leaves cuspidate to piliferous, margin entire.

B. albo-limbatum	B. capillare
Neck of the capsule not distinctly shrunken when dry.	Neck distinctly shrunken when dry.
Exothecial cells very narrow.	Exothecial cells broad.
Cells in the lid very narrow.	Cells in the lid broad.

10. Bryum torquescens Bruch , Bryol. Eur. fasc. 6-9,4:49. t 358. 1839. (Figs.25-28)

B. philippianum C. Muell., Linnaea 18:701.1844.

B. pyrothecium C. Muell. et Hamp., Linnaea 26:495.1853.

B. capillare Hedw. var. torquescens (Bruch.) Husn., Musc. Gall. 240.1889.

B. capillare Hedw. ssp. torquescens (Bruch.) Kindb., Eur.N.Am. Bryin. 2:358.1897.

B. erythropyxis C. Muell., Hedwigia 37:101.1898.

B. porphyreothrix C. Muell., Hedwigia 38:70.1899.

B. torquescentulum C. Muell., Hedwigia 38:71.1899.

B. decursivum C. Muell., Hedwigia 38:70.1899 (non C. Muell., 1898) hom. illeg.

B. pseudo-decursivum Par., Ind. Bryol. Suppl. 70.1900.

Plant loosely or densely tufted, green, sometimes tinged with red, 1 - 2½ cm high, repeatedly branched. Central strand of stem 25 - 53μ in diameter.

Rhizoids light brown to brown, finely papillose. Tubers red (young tubers orange or orange red, matured tubers red or crimson), with non-protuberant cells, rarely protuberant, on short and long rhizoids, never axillary, abundant, sometimes rarer, round, 75 - 255μ in diameter.

Leaves usually loosely set, not tufted at the tip of branches excepting at the fertile stage, when dry usually not strongly twisted around the stem, sometimes spreading or closely appressed, not much shrinking, narrow-ovate or spathulate, plane or concave, mucronate or cuspidate, ranging from 1.6 - 4.0 mm in length. Nerve excurrent, stronger than that of B. capillare, brown, reddish brown or red; margin distinctly toothed, sometimes with deep serration, rarely entire, recurved; border distinct, consisting of about 3-4 rows of narrow, thick elongated cells. Basal cells ± rectangular, elongated, 15-22 x 37-76μ; upper cells longly hexagonal,

rather narrower than B. capillare, 12-18 x 47-82μ.

Usually synoecious, rarely autoecious, male and female heads also found in separate plants (Fig. 28). Perichaetial leaves colourless, narrow, lanceolate with cuspidate apex; nerve excurrent; female paraphyses not coloured. Perigonial leaves much smaller than the vegetative leaves, ranging from 1 - 2 mm in length, broadly ovate, concave, awl-shaped, light orange or not coloured; nerve excurrent; male paraphyses orange, sometimes paler, apical cell of the paraphyses with acute tip. Antheridia at the tip of the branches.

Seta 2 - 3.5 cm long, lower portion reddish brown to crimson, upper portion brownish or reddish; seta without differentiated layer of cells around the central strand.

Capsule subcylindrical to cylindrical, 3 - 5 mm in length (without lid), cernuous or subpendulous, slightly contracted below the mouth when dry, symmetrical, reddish brown to crimson; mouth deep red or crimson, glossy; neck not shrunken when dry; exothecial cells at the mouth of about 1-2 rows of transversely elongated cells with strongly thickened transverse walls, longitudinal walls thin. Cells below the mouth ± regularly arranged in longitudinal rows, 15 - 41μ in breadth. Lid deep reddish brown to crimson, subhemispherical with long or short apiculate apex, cells 12 - 32μ in breadth, in broken concentric layers. Outer peristome teeth yellow with reddish tinge at the base, paler above; striations on the teeth arranged in transverse lines ± like finger prints. Inner peristome teeth suddenly converging at the apex and then ending in long projections.

Spores 9 - 11 - 15 - 16 μ in diameter.

England and Wales: Moorland, Carbis Bay, Cornwall (1), c.fr., Aug.1886, H.N. Dixon (as B. obconicum) (CGE). In chalk grassland on Goat Island, Dowlands landslip, South Devon (3), c.fr., April 1969, M.O. Hill. Rocky

ground, Swallow Cliff, Somerset (6), c.fr., March 1961, J. Appleyard. Quarry, West Cliff, Portland, Dorset (9), c.fr., April 1952, E.F. Warburg (OXF). Bare soil, the land slip, Cost of Ventnor, Isle of Wight (10), c.fr., April 1964, A.R. Perry and A.C. Crundwell (GL). South facing chalk slope, Oxenbourne Down, Petersfield, South Hants (11), c.fr., July 1959, J.A. Paton (B.B.S.). Sandy hedge bank near Petworth, West Sussex (13), c.fr., May 1903, W.E. Nicholson (as B. obconicum) (S-PA). Amberley Wild Brooks, West Sussex (13), c.fr., June 1907, W.E. Nicholson (as B. obconicum) (CGE). Southern slopes of the Coombe, Lewes (14), c.fr., May 1900, W.E. Nicholson (CGE). Open roadside bank, dry sandy soil, occasional between Aylesford and Sandling, Kent (16), Feb. 1952, T. Laflin (CGE). Canal bank near Kidlington, Oxfordshire (23), c.fr., June 1862 & '63, W. Holliday (OXF). Sea shore, Holme, Norfolk (27), May 1903, W.E. Thompson (B.B.S.). Chalk grassland, Devil's Dyke near Reach, Cambridgeshire (29), July 1958, H.L.K. Whitehouse (CGE). Brockenhurst, South Hants (11), c.fr., Feb.1878, E.W. Marquand (E). Cleeve Hill, Gloucestershire (33), c.fr., May 1857, I.H. Davies (OXF). Old quarry, Tidenham, West Gloucester (34), c.fr., June 1916, H.H. Knight (CGE). Vertical rock in old limestone quarry, Frome, North Herefordshire (36), c.fr., June 1937, C.H. Binstead (B.B.S.). Cliffs, south of Port Eynon, Gower, Glamorgan (41), April 1963, E. F. Warburg (as B. obconicum) (OXF). Harlech sandhills, Merioneth (48), c.fr., May 1913, D.A. Jones (B.B.S.). Hedge bank near Ripley, Yorkshire (64), c.fr., April 1859, I.H. Davies (as B. obconicum) (OXF). Near Barnard Castle, Durham (66), c.fr., June 1843, R. Spruce (as B. obconicum) (E).

Scotland: Near Dailly, Ayrshire (75), c.fr., July 1861, W. Wilson (as B. obconicum) (E). On Touch Bridge near Stirling (86), c.fr., Dec.1898, R. Kidston and J.S. Stirling (as B. obconicum) (GL). Wall on Darn road,

Kippenross, near Dunblane, Perthshire (87), c.fr., Sept.1895, R. Kidston (as B. obconicum) (GL).

Ireland: On wall above Muckross on Mangerton road, Kerry (H.2), c.fr., June 1885, S.A. Stewart (GL). On rock at small old quarry by road near town, Bundoran, Donegal (H.34), c.fr., June 1937, C.H. Binstead (B.B.S.).

Sweden. Gotland: St. Karlsö, June 1956, Åke Hovgard (as B. elegans) (S-PA).

West Germany. Sohren wald bei Mainz, May 1867, Ernst Zickendrath (S-PA).

Belgium. Philippeville, c.fr., 1840, L. Durien (BM). Murs du Chateau d'Argenteau prês Liège, c.fr., July, n.d., Marchal (S-PA).

France. Corsica: Auf sterilem Bodengegendas Tal des Fango bei Bastia, 30-40 m.s.m., c.fr., April 1905, Schiffner (S-PA); Near the old prison of St. Antonio, Ajaccio, c.fr., May 1901, Canus (CGE); Prope St. Sever in Agrosyrtico, Loco Landesde Mugriet, in terra arenosa 12 Junii (Spruce Musc. Pyren.), n.134 (BM). Antibes: Gallia meridionale, c.fr., April 1873 W.P. Schimper (OXF). Menton: c.fr., April 1928, C.H. Binstead (OXF). Jurancon: Ad muros Pyren. occidentalium locis Jurancon, Oloron et Bages, c.fr., Junio n.d., (OXF). Var: Le Gapeau valley, Hyères, c.fr., May 1929, W.E. Nicholson (CGE). Marseille: c.fr., 1857, Sarrat Gineste (BM). Alpes Maritimes: Sandy bank, Menton, c.fr., April 1928, C. Binstead (B.B.S.). Correze: On sandstone rock, Brive, c.fr., May 1902, G. Lachenaud (CGE). Charente Maritime: Ile de Re, Pinede du Fiers d'Ars, Charente, April 1959, J. Charrier (CGE). Oise: On sandy soil, Noailles, c.fr., May 1902, G. Lachenaud (CGE).

Spain. Castell de Fels pres Barcelone dans les Sables du litoral, n.d., K. Fremols (S-PA).

Mallorca (Majorca). Soller, auf erde über kalkgestein, 50 - 100 m, c.fr., May 1958, Friedlander (S-PA). Near the Gorch Blau, c.fr., June 1905, W.E. Nicholson (CGE).

Portugal. Algarve: On rock in wood, Caldas de Monchique, c.fr., Mar.1954, A.C. Crundwell (GL). Minho: Louro, May 1911, H.N. Dixon and W.E. Nicholson (CGE).

Azores. c.fr., n.d., Godman (MICH.).

Madeira Is. Poiso, c.fr., Mar.1937, Herman Persson (S-PA).

Switzerland. Vaud: Carriere jaune sur Ferreyres, 600 m., c.fr., Sept. 1920, Amann (S-PA). Monte Diaboli, spr.; (herb. Hedw-Schwaeg.) (G).

Italy. Auf Vulcanischer Tuff, Vesuv, 5-600 m., May 1901, Schiffner (MICH). Pisa: In sabulosis maritimis prope Pisa, c.fr., April 1887, Archangeli (S-PA). Lucca: In Pine forest, Viareggio, c.fr., Feb.1890, H. Boswell (OXF). Genova: Rapallo C. Genua, Val Foggia, auf der Erde, c.fr., April 1892, M. Fleischer (S-PA). Bolzano: Merano, Algund, c.fr., 1862, J. Milde (S-PA). Istria: M. Pirano, Müller (herb. Hedw.-Schwaeg.) (G).

Sardinia: Unio itineraria, in arenosis maritimis prope Cagliari, c.fr., 1827, Müller (as B. capillare var. corsicum) (E); Sardinien auf Meersand, c.fr., 1828, Müller (type of B. torquescens Bruch.) (BM).

Sicily: Messina: Ad parietes humidar, Messina al Lamaro, c.fr., Mar.1906,

J. Zodda (as B. obconicum) (S-PA). Taormina: c.fr., April 1914, W.E. Nicholson and H.N. Dixon (CGE).

Yugoslavia. Dalmatia: ad rupes, Dubrovnik, c.fr., Aug.1913, J. Podpěra (S-PA). Giblet von Zara, April 1913, J. Baumgartner (S-PA).

Greece. Euboea: c.fr., 1860, Unger (BM); Corfu: Achilleion in rupe calcareo, c.fr., Mar.1921, Gunnar Samuelsson (S-PA).

Crete. Slopes of Yuktas above Arkhanes, c.fr., May 1906, W.E. Nicholson (as B. obconicum) (CGE).

U.S.S.R. Azerbaydzhan: Transcaucasia: Lenkoran Stadt, Zeigelmaner am Meer bei der Apotheke, Sept.1894, Joh. Mikutowicz (S-PA).

Turkey. Mugla: On rock by stream 10 km north of Marmaris, 60 m., c.fr., April 1971, E. Nyholm and A.C. Crundwell (ACC). Aydin: Vertical roadside bank in forest, north side of Samsun Dag, south west of Davutlar, c.fr., 740 m., March 1971, E. Nyholm and A.C. Crundwell (ACC). Izmir: Bei Smyrna, c.fr., 1827, Fleischer (BM); On earth in fork of shrub in bank, ravine of river north-east of the village Bozdag, 1050 m., April 1971, E. Nyholm and A.C. Crundwell (ACC); On earthy side of wall, 10 km.west of Odemis, 50 m., c.fr., April 1971, E. Nyholm and A.C. Crundwell (ACC); Mt. Yamanlar, on earth covered exposed calcareous rock, about 250 m.a.s., April 1970, E. Nyholm. Pinarbasi, on horizontal cemented wall by canal, April 1970, C. Heckman, E. Kjellquist and E. Nyholm (E. Nyholm).

Lebanon. Beirut, c.fr., 1881, A.H. Brotherus (E); Sandy, stony hill slope just above the palace of Beit ed Din, 28 miles s. of Beirut, c.fr.,

April 1971, C.C. Townsend.

Iraq. Kurdistania Assyriaca: ditionis Erbill in reg. infer. m. Kuh - Sefin ad pageum Shaklava, 1000 m., c.fr., Sept.1893, J. Bornmüller (S-PA).

Iran. Tehran: On volcanic tuff, Tajrish, 1450 m., c.fr., Mar.1958, L.F.H. Merton (E).

Afghanistan. Mazar-i-Sharif: In faucibus fluvii Balkh, supra Aq Kupruk, 36°5N, 66°52E., ca. 700 - 800 m., n.d., K.H. Rechinger (S-PA).

Pakistan. Peshawar: on dry micaceous rock, about five miles south of Jabori in siran valley, Hazara, c.fr., June 1958, B.L. Burtt (E).

Nepal. Taylor (herb. Hedw.-Schwaeg.) (G).

Egypt. On granite, Sinai, 1950 m., April 1902, A. Knucker (S-PA). On rocky slopes about the little monastery N. Santa Catherina, April 1971, Mary Grierson (Townsend).

Africa. South Africa: Cape Province; hole on stone, peninsula between Trappies Kop and Cave Peak, c.fr., Sept. 1951, Sigfrid Arnell (S-PA); Cape Town 1875 Dr. A. Rehman (isotype of B. decursivum C. Muell.) (S-PA); In umbrosis prope Blanco, 1875, A. Rehman (B. porphyreothrix C. Muell.) (S-PA); Cap, c.fr. 1824, Ecklon (type of B. torquescentulum C. Muell.) (S-PA); Cape of Good Hope, Menzies (herb. Hedw.-Schwaeg.) (G). Kenya: Rift valley, pres de Naivasha, 1900 m., c.fr., Aug.1929, H. Humbert (S-PA). Morocco: Shaley slopes and banks in Quercus Ilex association from Azrou to Khenifra, 850 m., c.fr., April 1969, P. & J. Davies (E). Rochers fraids,

bords du Bou Regreg, Rabat, c.fr., April 1924, E. Jahandiez (CGE). Tunisia: Bizerte, c.fr., April 1936, Boivard (S-PA). Dougga, c.fr., April 1929, Nukler (MICH). Algeria: in collibus petrosis apricis, Kabylia minor, Ras Aokas (Beni-M'hamed), c.fr., Mar. 1866, Paris (S-PA). Monts de Tlemcen; forêt de Tessera Marmet, a terro. Alt. 1375 m., c.fr., Aug. 1949, F. Jelenc (B.B.S.). Cape Verde Islands: ad terram prope Jurancon, Maio, c.fr., n.d. (OXF).

China. Yunnan: Matted plant of one inch on dry rocks, Bei-ma-Shan, N.W. Yunnan, c.fr., Sept. 1921, George Forrest (E).

Australia. South Australia: Cheltenham near Melbourne, c.fr., Aug. 1885, A. Morrison (E). Victoria: c.fr., Mar.1872, A. Morrison (E); Moe Swamp (type of B. pyrothecium C. Muell. et Hamp.) (BM). N.S. Wales: Cambewarre, Dec.1885, Whitelegge (type of B. erythropyxis C. Muell) (S-PA).

New Zealand. Otago: Consolidated edges of damp shingle slips in open, Arrow river, 1100- 1200ft., c.fr., Dec.1964, J.T. Linzey (GL). New Zealand (Antarct. Exp.), 1839-'43, I.D. Hook (S-PA).

North America. Mexico: Mineral Del chico, state of Hidalgo, c.fr., May 1925, C.R. Orcutt (MICH). Peak of Orizaba, Veracruz, c.fr., 1838, J. Linden (MICH).

U.S.A.: California; Santa Clara Co., In grassy places by road-sides, foothills near Stanford University, c.fr., Mar.1902, C.F. Baker (S-PA); Calaveras Co., San Antonio Creek 6 miles north of Altaville, c.fr., May 1947, L.F. Koch (MICH); San Francisco Co., In Golden Gate park, c.fr., July - Aug. 1947, L.F. Koch (MICH); Marin Co., on ground in Oak woodland, Black Point, c.fr., April 1949, J. Thomas Howell (MICH); Tuolumne Co., Rocky gully with occasional small pond, one half mile east of Stanislaus

county line, c.fr., May 1947, J.Shirely and L.F. Koch (MICH); Sonoma Co., Adobe canyon near Kenwood, c.fr., Sept.1947, L.F. Koch (MICH); Napa Co., road from Napa to Monticello, May 1947, Leo and Shirely Koch (MICH).

South America. Chile: In regno Chilensi, Philippi (type of B. philippianum C. Muell) (BM).; Quidico pa tradstubbar, Nov.1896, c.fr., P. Dusen (as B. philippianum) (S-PA).; Chile australis ad corral portum in rupibus, c.fr., Nov.1896, P. Dusen (as B. philippianum) (S-PA).

Bryum torquescens grows on grassland, road-side grassy places, earthy banks, sandy soil, volcanic tuff, rarely on walls and earth-covered calcareous rocks but never on tree trunks. It is found in all the continents but tends to be distributed in warmer regions.

Most authors have regarded it merely as a variety under B. capillare, the main distinguishing feature being that it is synoecious; but as this is not constant, it is not a very satisfactory diagnostic character. However, none of the other species in the group ever bears synoecious inflorescences. One of its best distinguishing features is the presence of red as opposed to reddish brown tubers. Specimens of B. torquescens without synoecious inflorescens have usually been misunderstood as B. obconicum Hornsch.

B. torquescens is the most frequent fruiting species in the group. Frequent occurrence of synoecious inflorescence may be one of the causes of its high fertility.

The information about B. fuscescens spruc. in the Index Muscorum is incorrect. Spruce's original specimen (BM) is labelled as B. torquescens Bruch. I have examined the specimen and it is B. torquescens Bruch. The name "fuscescens" I have been unable to trace outside the Index Muscorum.

According to Index Muscorum the original description of B. torquescens Bruch is in De Notaris' Syllabus Muscorum n.163. 1838. This reference is wrong. Other authors give Fl. Sard. Exs. 1828, but I suspect that the specimen was not accompanied by any description. The first description that I have seen, is that in the Bryologia Europea fasc. 6-9 (vol.-IV) p.49, t. 358 (1839). I have taken this as the original one.

A number of other characters in which it differs from B. capillare are given below:

B. torquescens	B. capillare
Rhizoids light brown to brown.	Rhizoids brown to deep reddish brown.
Tubers red (orange-red when young, deep red or crimson at maturity), cells nonprotuberant or protuberant.	Tubers brown to deep reddish brown; cells nonprotuberant.
When dry leaves usually not strongly twisted.	When dry leaves strongly spirally twisted around the stem.
Leaves ovate-spathulate, sometimes narrowly spathulate.	Leaves narrow or broadly obovate-spathulate.
Leaves usually mucronate to cuspidate.	Leaves cuspidate to piliferous.
Nerve always excurrent.	Nerve sometimes vanishing below the summit.
Upper cells of the leaf narrow, hexagonal.	Upper cells of the leaf broad, hexagonal.
Synoecious, autoecious or dioecious.	Dioecious.

B. torquescens	B. capillare
Nerve of the perigonial leaves usually excurrent.	Nerve of the perigonial leaves nonexcurrent.
Apical cell of the male paraphyses with acute apex.	Apical cell of the male paraphyses with round apex.
Antheridia at the tip of the branches.	Antheridia at the tip of the branches as well as in the axils of perigonial leaves.
Capsule subcylindrical to cylindrical.	Capsule subcylindrical to pyriform.
Capsule when dry slightly contracted below the mouth.	Capsule when dry strongly contracted below the mouth.
Neck suddenly tapering towards seta.	Neck gradually tapering towards seta.
Neck not distinctly shrunken when dry.	Neck distinctly shrunken when dry.
Capsule reddish brown to crimson.	Capsule brown to reddish brown.
Mouth of the capsule deep red to crimson.	Mouth of the capsule deep brown to deep reddish brown.
Exothecial cells at the mouth of about 1-2 rows of transversely elongated cells with distinctly thickened transverse walls and thin longitudinal walls.	Exothecial cells at the mouth not forming any distinct transverse layer.

B. torquescens	B. capillare
Cells below the mouth arranged regularly in longitudinal rows.	Cells below the mouth not in longitudinal rows.
Lid subhemispherical with longly apiculate apex, sometimes with shorter apex.	Lid conical-apiculate.
Cells of the lid more incrassate, narrower and longer than B. capillare.	Cells of the lid less incrassate, shorter and broader than B. torquescens.
Striations on the outer peristome teeth arranged in transverse lines, $\pm$ like finger prints.	Striations on the outer peristome teeth not forming any definite pattern.
Inner peristome teeth suddenly converging at the apex and end in long projections.	Inner peristome teeth gradually tapering at the upper end.

11. Bryum jamaicanse Syed, n.sp. (Figs. 29,30,36)

Planta laxe caespitosa, viridis, plerumque rufa suffusa, mollis, ½ to 2½ cm alta, repetite ramosa. Filum centrale caulis 15 - 35μ diam.

Rhizoidea brunnea ad profunde rufo brunnea, subtiliter papillosa. Tubera 190 - 250μ diam, in rhizoidis brevibus et longis, nunquam axillaria, rubra vel rufo-aurantiaca, abunda ad sparsa, sphaerica, papillis longe projectis, apicibus papillarum rotundatis.

Folia laxe vel dense disposita, molles, ovata ad ovato-spathulata, 1.5 - 3.5 mm longa, plana vel leviter concava, in sicco plerumque paulo contracta, vulgo expansa, aliquando circum caules laxe torta; mucronata, interdum cuspidata; costa non excurrens, nonnunquam ad apicem accedens, brunneola ad rufo-brunnea; margo plerumque supra subtiliter denticulata, leviter recurvata, distincta, cellulis elongatis 2 - 4 seribus composita, cellulae 2 - 3 serierum intra crassae in folis veleribus, plerumque brunneolo - lutea. Cellulae basales ± rectangularis, non porosae, 15 - 31μ x 32 - 190μ; cellulae superae ± hexagonae, non porosae, 9 - 20μ x 44 - 88μ.

Dioica. Folia perichaetiales angusta, spathulata, mucronata vel cuspidata; costa brunneola, non excurrens; paraphyses incolorata. Folia perigoniales multo pusilliores quam folia vegetativa, 0.9 - 1.5 mm longa, ovata, concava, rufa suffusa, costa non excurrentia, paraphyses aurantiaca. Antheridia ad apices ramorum disposita.

Seta 2 - 2.5 cm longa, ad basin profunde brunnea, insuper brunnea; cellulae circum filum centralem non differentiatae.

Capsula subcylindrica, collo proprio, 2 - 3.5 mm longa (sine operculo), cernua, in sicco non contracta infra orificium, orificium capsulae leviter quam basim angustior, pallido - brunnea, orificium profunde brunneum, nitidum, collum non distincte, contractum in sicco; cellulae exotheciori ad orificium ± ovales, cellulae in 2 seribus transverse elongatae parvae,

infra in circa 5 seriebus breves; cellulae infra orificium longitudine dispositae, 12 - 31μ latae.

Operculum conicum, apice obtuso, brunneum vel brunneolo - aurantiacum, cellulae in stratis concentricis non distinctis, 6 - 22μ latae.

Sporae 12 - 16μ diam.

Jamaica. Ad margines silvae, Portland Gap, Ins Jamaica, alt. 1650 m., c.fr., July 1926, W.R. Maxon (type of B. jamaicanse Syed) (S-PA).

Guatemala. Quezaltenango: damp bank in Alnus forest, south east of San Martin Chile Verde, region of Boxantin, alt. about 2400 m., c.fr., Jan.1941, Paul C. Standley (as B. capillare) (S-PA). Suchitepequez: south slope of volcan santa clara, 4000 ft., c.fr., July 1948, L.R. Holridge (as B. capillare) (MICH).

Mexico. Chiapas, bank of trail, north slope of Sierra, north of Mapastepec, 6000 ft., c.fr., Nov. 1945, A.J. Sharp, n.4604 (as B. capillare) (MICH).

Bryum jamaicanse is a species growing on soil. It seems to be restricted to the southern part of North America. North American bryologists have misunderstood it as B. capillare Hedw.. B. jamaicanse can be readily distinguished from B. capillare by the colour and protuberance of its tubers. I have not seen any type material similar to B. jamaicanse and therefore describe it as a new species. A number of important characters in which it differs from B. capillare are given below:

B. jamaicanse	B. capillare
Tubers red or reddish orange; round with long projected mamillae.	Tubers brown to deep reddish brown; round or oval or irregular; their cells nonprotuberant.
Leaves not much shrinking when dry, usually spreading, sometimes loosely twisted around the stem.	Leaves usually much shrinking when dry, strongly spirally twisted around the stem.
Leaves ovate to ovate-spathulate.	Leaves narrow or broadly obovate-spathulate.
Leaves mucronate to cuspidate.	Leaves cuspidate to piliferous.
Leaf cells nonporose.	Leaf cells rarely porose.
Perichaetial leaves with nonexcurrent nerves.	Perichaetial leaves always with excurrent nerves.
Antheridia only at the tips of the branches.	Antheridia at the tips of the branches as well as in the axils of perigonial leaves.
Capsule not contracted below the mouth when dry.	Capsule strongly contracted below the mouth when dry.
Neck not distinctly shrunken when dry.	Neck distinctly shrunken when dry.
Exothecial cells at the mouth forming two rows of transversely elongated cells.	Exothecial cells at the mouth not forming any distinct transverse layer.

B. jamaicanse	B. capillare Taf
Cells below the mouth arranged in longitudinal rows.	Cells below the mouth not in longitudinal rows.
Lid conical with blunt tip.	Lid conical-apiculate.
Cells in the lid not in distinct concentric layers.	Cells in the lid arranged in concentric layers.

Section III

STUDY OF SPORES (Fig.31)

Attempts were made to study the ornamentations of the outer surface of the spore walls of different species of the group with a view to investigating whether there are any differences between them in this respect or not. I studied them under the light microscope with a maximum magnification of X1000, but this did not give successful results. The spores of B. erythroloma and B. stirtonii were found to be coarsely papillose, but I could not ascertain any difference between them. For other species, it was difficult to say whether their spores are smooth or finely papillose. For these reasons photographs of the spore walls of all the fertile species have been taken under Scanning Electron Microscope with a magnification of X6000 and X12000 for each of the species.

The electron micrographs have shown that the spore walls of all the species are ornamented with papillae. The papillae differ from one species to another in shape, size, degree of protuberance and distribution. It is difficult to describe them accurately, but on the basis of their nature I have divided them into three main types:

Type-I, Simple: Papillae which occur singly.

Type-II, Compound: Papillae which occur in lumps.

Type-III, Mixed: Papillae which occur both singly and in lumps.

Type-I includes B. erythroloma, B. stirtonii, B. pseudocapillare and B. elegans, type-II includes B. albo-limbatum and type-III includes B. laevifilum, B. flaccidum, B. jamaicanse, B. torquescens and B. capillare.

In B. erythroloma the papillae are of equal size, big, projecting with round tips and evenly distributed on the spore wall. B. stirtonii shows a similar type of ornamentation, but the papillae are more distantly placed

than in B. erythroloma and are unequal in size.

In B. pseudocapillare the papillae are distributed in small and in large groups. B. elegans is similar to B. pseudocapillare, but here the papillae are smaller than those in B. pseudocapillare and more projecting; some of them seem to run into one another.

On the other hand, B. laevifilum shows the presence of mixed papillae; here the papillae are distributed singly as well as in big lumps. In B. flaccidum the ornamentation is similar to B. laevifilum, but the compound papillae are smaller than those of B. laevifilum. B. torquescens and B. jamaicanse are similar, but in B. torquescens the papillae seem to occur in distinct patches and in B. jamaicanse some of them seem to run into one another. B. capillare shows an ornamentation similar to B. torquescens, but the papillae are smaller.

B. albo-limbatum shows a different pattern of ornamentation; here the papillae are in big lumps. These papillae are $\pm$ cushion-like and velvety in texture.

It is clear that there is a wide range of variation in the ornamentation of the spore wall within the group. It would however be rash to attach too much taxonomic significance to these observations as limited facilities have made it impossible to study with the electron microscope the range of variation within each species. Nevertheless it is fairly certain that the more striking differences as between B. erythroloma and B. albo-limbatum, for instance, are of taxonomic significance; and this is in accordance with observations under the light microscope on a larger number of spores.

CHAPTER 3.

DISTRIBUTION OF ANTHERIDIA (Fig.32)

The distribution of antheridia in B. capillare Hedw. and in other species in the group has been found to be a subject of interest. According to the position of antheridia they have been divided into two groups:

Group I - Those having all the antheridia at the tip of antheridial branch surrounded by perigonial leaves.

Group II - Those having antheridia also in the axils of perigonial leaves.

Group I includes B. torquescens and B. jamaicanse, and group II includes B. capillare var. capillare, B. elegans, B. stirtonii, B. flaccidum, B. laevifilum, B. erythroloma, B. albo-limbatum and B. pseudocapillare. Male heads of B. subelegans and B. capillare var. rufifolium were not found and accordingly they could not be discussed here.

Male heads were embedded in paraffin wax by the Xylol-Alcohol method (Johansen 1940) and cross sections were cut at 15μ. The sections were stained with Fast Green (1% Fast Green in absolute alcohol) and mounted in Canada Balsam.

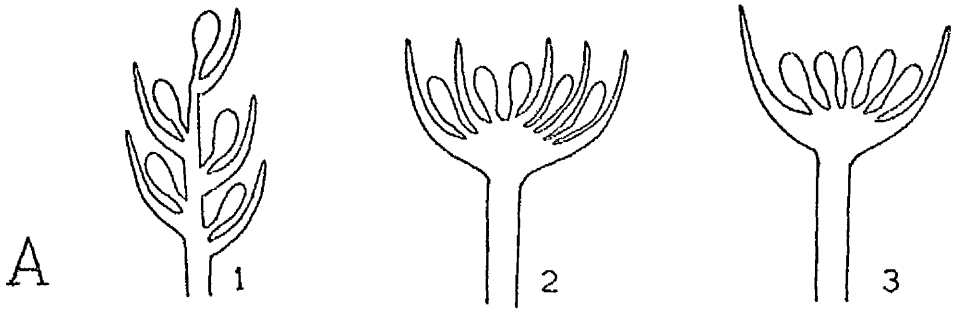
In mosses, excepting the paroecious forms, none is known to bear axillary antheridia with the exception of Sphagnum which is well known in bearing antheridia in the axils of perigonial leaves. Gerstner (1925) in his discussion about the arrangement of the sex organs in mosses, illustrated a number of species. In his paper, the illustrations of male heads of B. capillare, Mnium affine, M. undulatum, M. seligeri, M. orthorrhynchum, M. stellare and Aulacomnium palustre showed the presence of axillary antheridia which are not confined to the axils of uppermost perigonial leaves, but occur in the axils of lower perigonial leaves as well. Though these were evident in Gerstner's illustrations, he did not mention anything regarding this problem.

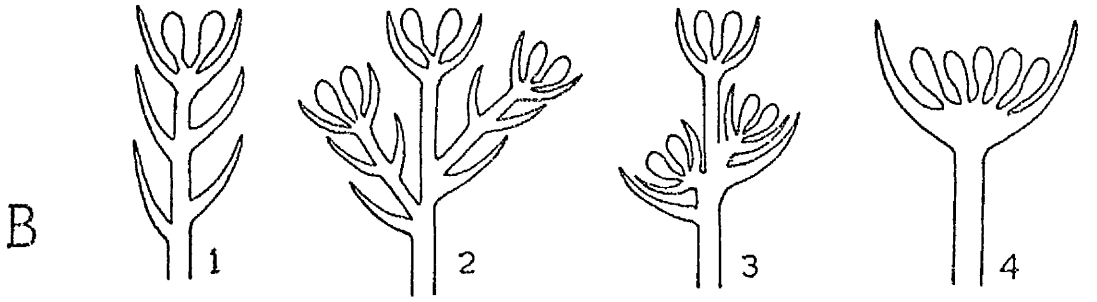
In all the species of the capillare group, the male heads are borne

always at the tips of branches. In B. torquescens and B. jamaicanse all the antheridia are terminal in position and surrounded by perigonial leaves (Fig.32 h,i). Synoecious heads of B. torquescens have also been studied and sex organs are found to be distinctly terminal in position. Perigonial leaves are not found to bear any antheridia in their axils in these two species, which have male heads of the normal moss type. It is hardly possible to be certain that none of the antheridia is axillary to the uppermost perigonial leaves, but they show no definite evidence of this. In the species of group II, on the other hand, there are antheridia which are undoubtedly axillary in position, for they are in the axils of perigonial leaves that do not belong to the uppermost cycle (Fig. 32 a-g, j, k)

B. capillare var. capillare also shows aggregation of more than one male head at the tip of branch (Fig. 32 a). This condition seems to be very rare and I have seen it once only. In B. pseudocapillare, both types of male heads are found to occur (Fig. 32 k,l).

The interpretations regarding the position of antheridia in B. capillare can be made in two possible ways on the basis of the following two sets of diagrams 'A & B'.





If the occurrence of axillary antheridium (A_1) is taken as a primitive feature, then possibly the capillare type of male head is a result of reduction of the internodes between the perigonial leaves (A_2) and further reduction in the perigonial leaves has made the antheridia distinctly terminal (A_3), characteristic of B. torquescens and B. jamaicanse and most other mosses.

Alternatively, if the occurrence of terminal antheridia (B_1) is taken as a primitive feature, then an aggregation of a number of similar branches (B_2, B_3) creates a condition similar to that of paroicious forms and a further reduction in the respective branches (B_4) makes a condition similar to that of B. capillare. One of the difficulties with 'B' is that the stages B_2 and B_3 are not found in B. capillare or in other species with axillary antheridia. 'A' therefore seems more probable than 'B'.

EXCLUDED SPECIES

Bryum squalidum Brid., Musc. Rec. 2(3):52.1803 (B. squalidum Vill. 1786 nom. inval.) was regarded as a synonym of B. capillare and has been accepted as such. I have seen the very scanty material of it from Hedwig-Schwaegrichen's herbarium, Geneva, and found the specimen to be B. pseudotriquetrum Schwaeg. of which B. squalidum is therefore a synonym.

B. obconicum Hornsch. in B.S.G., Bryol. Eur. 4:129.376.1839 (fasc. 6-9 Mon. 59.27). This species was described from Zweibruchen. The type specimen (S-PA) belongs to B. pallescens Schleich. of which B. obconicum is therefore a synonym. It has been mostly misunderstood and usually regarded (e.g., Dixon 1924) as a subspecies of B. capillare. Most herbarium specimens that have been given this name belong to B. torquescens Bruch.

B. creberrimum Tayl., London Journ. Bot. 5:54.1846. This species was described from 'Swan River', Australia, and was collected by Mr. James Drummond. I have seen from the Natural History Museum, London, sheets containing many specimens of B. creberrimum, a number of which were collected from Swan River by Mr. James Drummond. I have examined all of them and found all belong to the same species. Ochi (1969) regarded it as a synonym of B. capillare. In his paper he referred to two unnumbered specimens (BM) collected by Synclair from Swan River and two numbered specimens (BM) collected by J.D. Hooker from New Zealand. Ochi has not said anything about James Drummond's specimens in his paper. He apparently regarded the New Zealand specimens to be the syntypes of B. creberrimum. Quite apart from Ochi's mistake as to which specimen should be regarded as type, I cannot accept his identifications, for I have examined the specimens to which he referred and have found none to be

B. capillare and all identical with Drummond's material. B. creberrimum and B. affine Lindb. are now regarded as synonyms, and this I have found to be correct. B. affine is an illegitimate name and B. creberrimum is an earlier valid name, so, 'creberrimum' stands as a valid epithet for this species. It has nothing to do with B. capillare.

B. speirophyllum Kindb., Bull. Soc. Bot. Ital. 1895:17.1895.

This species was described from Monte Generoso. The type specimen (S-PA) belongs to Tayloria serrata (Hedw.) B.S.G., of which B. speirophyllum is therefore a synonym. Andrews (in Grout 1940) regarded it as a synonym of B. capillare. This was presumably the result of examining only North American material, most of which is B. erythroloma Kindb.

B. sanguilentum Ren. et Card., Rev. Bryol. 20:31.1893 nom.nud.

B. trichophorum Kindb., Eur. N. Am. Bryin. 2:359.1897.

B. gemmascens Kindb., Eur. N. Am. Bryin. 2:360.1897.

After the investigation of the type specimens of the three species, I am convinced that they are the same. B. trichophorum and B. gemmascens are described from vegetative tufts. B. sanguilentum was found to be a fruiting specimen, but no description of it has ever been published and it is therefore a nomen nudum. B. trichophorum and B. gemmascens are validly published legitimate names for this species. They were published simultaneously and I have chosen 'gemmascens' as the epithet for this species.

A few plants in the type specimen of B. trichophorum have axillary filamentous gemmae. The type specimens of B. sanguilentum and B. gemmascens bear no such gemmae, but do contain the same type of tubers as in the type specimen of B. trichophorum. At present it is difficult to say anything about the cause of the presence and the absence of the axillary filamentous gemmae, but in other species e.g., in B. pseudocapillare

it has been noticed that sometimes the plants bear axillary filamentous gemmae and sometimes they do not. This may well be the case with this species. Excepting the occurrence of filamentous axillary gemmae, the type of B. trichophorum does not differ in any other characters from the other two.

B. gemmascens is described below and illustrated (Fig. 33,34). I think it is a member of the section Trichophora but not closely related to B. capillare.

B. gemmascens Kindb. (Fig. 33,34)

Plant loosely or densely tufted, light green, repeatedly branched, leaves often appearing bud-like at the apices of branches, ½ - 2 cm high, central strand of stem 20 - 45 μ in diameter.

Rhizoids light brown, finely papillose. Tubers brown, round, 65 - 200 μ, or oval, 65 - 150 x 95 - 250 μ, scattered. Filamentous gemmae sometimes present in the axils of leaves, brown, finely papillose, 18 - 32 μ in breadth.

Leaves loosely or densely set, subovate-lanceolate, soft, non decurrent, not twisted round the stem, closely appressed and not shrinking when dry, 1½ - 2½ mm in length, plane, cuspidate; nerve excurrent or vanishing below the apex, apex of the leaf ending in a colourless arista; margin smooth, not recurved, border not distinct. Basal cells rectangular, 18 - 32 x 27 - 63 μ, porose; upper cells ± hexagonal, 12 - 19 x 24 - 50μ, rarely porose.

Dioecious. Perichaetial leaves similar to vegetative leaves or slightly narrower; female paraphyses not coloured. Perigonial leaves ovate, concave, 0.8 - 1 mm in length, male paraphyses light brown. Arrangement of antheridia as in B. capillare.

Capsule ± cylindrical, 2 - 4.5 mm in length (without lid), with a distinct

neck, cernuous, slightly contracted below the mouth when dry, symmetrical, brown to reddish brown, sometimes crimson at the upper half, mouth reddish brown to crimson, glossy; neck not distinctly shrunken when dry; exothecial cells at the mouth ± hexagonal, forming about five rows of short cells, not in longitudinal rows, not forming any layer of transversely elongated cells, cells below the mouth not in longitudinal rows, 12 - 40 μ in breadth. Lid brown to reddish brown, conical-apiculate, cells arranged ± in concentric layers, 9 - 22 μ in breadth.

Spores 12 - 15 μ in diameter, finely papillose.

U.S.A. California: Santa Clara Co., foothills near Stanford Univ., c.fr., March 1902, Baker (S-PA) (as B. sanguilentum); Marin Co., Mill Valley, on stump of Sequoia sempervirens, c.fr., April 1892, M.A. Howe (S-PA) (type duplicate of B. sanguilentum); Santa Rosa Co., on rocks, two miles of Santa Rosa, c.fr., March 1902 (S-PA) (as B. sanguilentum). Montana: Columbia Falls, Oct. 1896, Williams (S-PA).

Canada. British Columbia, Vancouver: On rocks by the sea, June 1893, Macoun(CAN) (type of B. gemmascens); Cadboro Bay, on rocks by the sea, May 1893, Macoun(CAN) (type of B. trichophorum); boulder by the sea, June 1893, Macoun (S-PA).

B. moravicum Podp., Vestn. Klub. Prirod. Prost. 8:41.1906, which has been described from Moravia. I have seen the type specimen of it from the Stockholm Natural History Museum. The species has been described from sterile tufts. The extremely narrow ovate leaf with strongly thickened nerve is not the characteristic feature of any species close to B. capillare. I believe it is related to the Asiatic species, B. courtoisii Broth. It differs from B. courtoisii mainly in the shape of the leaf and the thickness of the leaf border. In B. courtoisii, the leaf border is thick and broad, but in B. moravicum it is thin and narrow and its leaves are narrower than

those of the former. B. moravicum has been described below and illustrated accordingly.

Bryum moravicum Podp. (Fig.35)

B. capillare Hedw. var. moravicum (Podp.) Podp., Act. Ac. Sc. Nat. Morav. 22:397.1950 nom. inval. in synon.

Plant loosely tufted, light green, sparsely branched, 1 - 2 cm high. Central strand of stem 30 - 63 μ in diameter.

Rhizoids pale yellowish brown to brown, finely papillose. Tubers scattered, round, 90 - 175 μ in diameter or oval 125 - 130 x 140 - 160 μ. Filamentous gemmae in the axils of leaves brown, finely papillose, mostly unbranched, 24 - 33 μ in breadth.

Leaves loosely set, very narrow, ovate, soft, not twisted round the stem but spreading, not much shrinking when dry, 1.7 - 2.5 mm in length, very narrow-ovate, nerve very wide at the base, about as wide as the base, excurrent in a long cuspidate point; margin consisting of 1-2 rows of narrow elongated cells; border not distinct. Basal cells ± rectangular, 15 - 22 x 27 - 78 μ; upper cells ± hexagonal, 12 - 16 x 36 - 60 μ; cells rarely porose.

Sex organs and sporophyte not found.

Czechoslovakia. Ivancice: Ad rupes, conglomerata permica pr. Reznovice, April 1905, Dr. J. Podpěra (type of B. moravicum) (S-PA).

B. courtoisii Broth. et Par., Rev. Bryol. 35:41.1908. I have seen the type specimen of it from Paris. Ochi (1956) described B. higoense as a new species from Japan but later (1967) reported that it was a synonym of B. courtoisii. I believe it is a member of the section Trichophora but not closely related to B. capillare.

B. rubro-limbatum Broth., Philipp. J. Sc. 5C:147.1910. This species was described from Luzon. I have seen the Isotype material (BM) of it. The material contained profuse tubers. The tubers are red, their cells are protuberant, so that the tubers appear ± star-shaped. Ochi (1957) treated B. rubrolimbatum as a synonym of B. nagasakense Broth. which he made a variety of B. capillare. I have seen the type specimen of B. nagasakense from Helsinki and have been unable to agree with him. The tubers of B. nagasakense which are identical to those of B. capillare are altogether different from those of B. rubro-limbatum. Moreover, the leaf shape of B. rubro-limbatum has been another factor against treating it as close to B. capillare. It seems to me that this species may be closer to the B. erythrocarpum group. It has certainly nothing to do with B. capillare.

B. yünnanense Broth., Sitzungsber. Ak. Wiss. Wien Math. Nat. Kl. 133:570.1924. I have seen the type specimen of it from Helsinki. The material did not contain any gemmae. The leaves are ± lanceolate with a very strong and thick excurrent nerve. It is not related to B. capillare.

CHAPTER 5.

DOUBTFUL SPECIES

It has not been possible to see the type specimen of all the species which have been reported to be related to B. capillare Hedw. Those species whose type specimens could not be procured are included in this chapter. Though I believe it is not correct to comment too definitely on any species without examining its type, yet, from the original descriptions of the doubtful species, a probable status for them is drawn out here.

The following species are regarded as synonyms for B. capillare by Ochi (1970). I think these may be correct.

B. immarginatum Broth., Oefv.Finsk. Vet. Soc. Foerh. 35:50.1893.

B. plebejum C. Muell., Hedwigia 37:94.1898.

B. microsporum Broth., Oefv.Finsk. Vet. Soc. Foerh. 42:100.1899.

B. leptothecioides Broth. et Watts, Proc. Linn. Soc. N.S. Wales 40:374.1915.

B. icodense Wint., Hedwigia 55:108.5.1914 is also, from the original description, very likely a synonym for B. capillare.

The following species are likely to be synonyms for B. elegans Nees.

B. restitutum De Not., Cronac. Briol. Ital. 1:26.1866.

B. pfefferi De Not., Atti. Univ. Genova 1:409.1869.

B. pseudofunkii Anzi, Mem. R. 1st. Lombard. Sc. Lett. Milano 13:332.1877.

The following two species may well be synonyms for B. stirtonii Schimp.

B. suecicum Kindb., Eur. N. Am. Bryn. 2:361.1897.

B. taitumense Card., Beih. Bot. Centralbl. 19(2):110.II.1906.

B. triste De Not., Cronac. Briol. Ital. 1:26.1866. I have seen a few specimens identified as B. triste from Natural History Museum, Stockholm, and these are all B. flaccidum. It may well be a synonym for B. flaccidum.

The following two species are likely to be synonyms for B. pseudocapillare Besch.

B. floridanum Ren. et Card., Rev. Bryol. 20:4.1893 nom nud.

B. bernouillii C. Muell., Bull. Herb. Boiss. 5:183.1897.

The following species may well be synonyms for B. torquescens Bruch.

B. oreganum Sull., U.S. Expl. Exp. Wilkes Musci 10.7b.1859.

B. rosulatulum C. Muell., Flora 73:474.1890.

B. synoicum C. Muell., Hedwigia 37:96.1898.

B. sydowii Podp., Beih. Bot. Centralbl. 15:490.1903.

B. oligogynum Philib. in Amann, Fl. Mouss. Suise 3:112.1933.

Ochi (1970) regarded B. synoicum as a synonym for B. capillare, but as the name itself refers to the presence of synoecious inflorescens, I think, it is likely to be a synonym for B. torquescens.

B. subdrepanocarpum Card. et Thér., Bot. Gaz. 37:374.22f.2.1904. This species shows biseriate leaf margins and hence, I think it may be a synonym for B. donianum Grev.

By studying the original descriptions of the following species I have not been able to make any probable suggestion for their status:

B. botterii C. Mohr. ex C. Muell., Linnaea 38:622.1874.

B. contortum Stirt., Proc. Nat. Hist. Soc. Glasgow 2:187.1876.

B. vulcanicolum C. Muell., Bull. Herb. Boiss. 5:184.1897.

B. lonchopyxis C. Muell., Hedwigia 38:72.1899.

B. capense (C. Muell.) Podp., Act. Ac. Sc. Nat. Morav. 22:439.1950 (B. capillare var., 1848).

SUMMARY

A taxonomic revision of Bryum capillare Hedw. and the species commonly confused with it has been carried out. It has been found to be a complex of eleven species and one variety. These are: B. capillare Hedw. var. capillare, B. capillare Hedw. var. rufifolium (Dix.) Podp., B. elegans Nees ex Brid., B. stirtonii Schimp., B. subelegans Kindb., B. flaccidum Brid., B. laevifilum Syed, B. pseudocapillare Besch., B. erythroloma (Kindb.) Syed, B. albo-limbatum (Hamp. et C.Muell.) Jaeg., B. torquescens Bruch., and B. jamaicanse Syed. B. laevifilum and B. jamaicanse have been described as new species. All have been fully described and figured and their geographical distribution recorded.

Efforts have been made to distinguish the species while they are sterile, for most of the species in the capillare group do not fruit frequently. Tubers and axillary filamentous gemmae have been found to be important characters for sorting out the various species in the vegetative condition. Rhizoid characters have been found to be important for distinguishing B. elegans from other species in the group.

Studies on the ornamentations of the spore walls of the different species under the Scanning Electron microscope have revealed that there are differences between them which are taxonomically significant.

Studies of the geographical distribution of the species showed that B. erythroloma, B. pseudocapillare and B. jamaicanse are restricted to North America, B. albo-limbatum is an Australian species, B. elegans and B. subelegans are reported only from Europe and the rest of the species are found in several continents.

The arrangement of the antheridia in the various species has proved interesting. In some of them the antheridia are borne terminally, which

is the normal situation. In others there are both terminal antheridia and antheridia in the axils of the perigonial bracts. Axillary antheridia have previously been reported only in Sphagnum and in paroecious mosses, and their discovery in Bryum raises the question of whether their primitive position in mosses is lateral or terminal.

The examination of the type specimens of species that have been reported as synonyms with B. capillare showed that several were not in fact closely related to it. Some of them proved to belong to other sections of the genus, but two, Bryum moravicum Podp. from Czechoslovakia and B. gemmascens Ren. et Card. from North America, belong to the same section (Trichophora) as B. capillare though not closely related to it. They appear to be good but neglected species and have both been fully described and figured.

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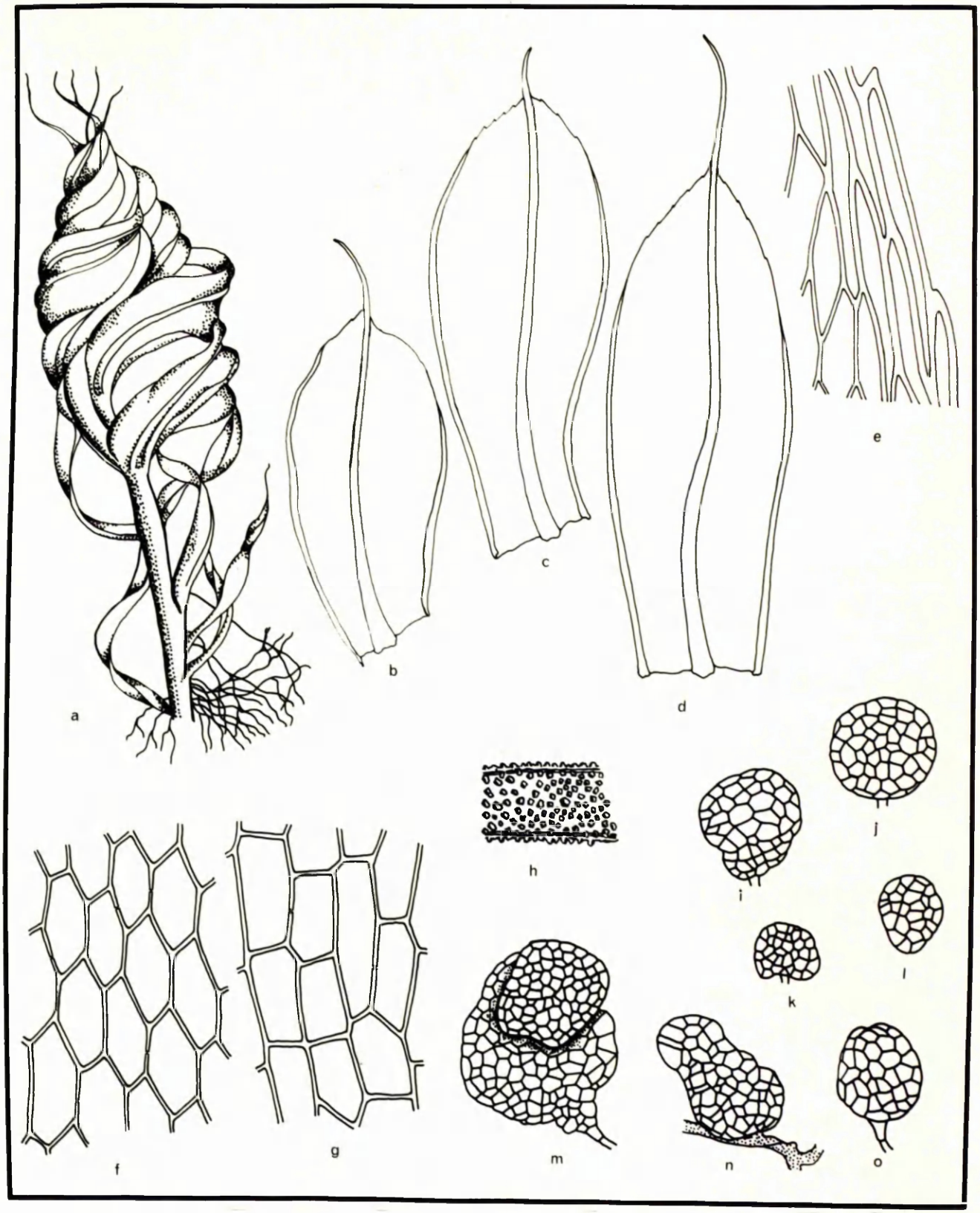
ILLUSTRATIONS

Fig. 1. B. capillare Hedw. var. capillare, from plant from England. a, plant dry; b-d, leaves; e, cells at margin of leaf; f, cells in middle; g, cells at base; h, a portion of rhizoid; i-o, tubers.

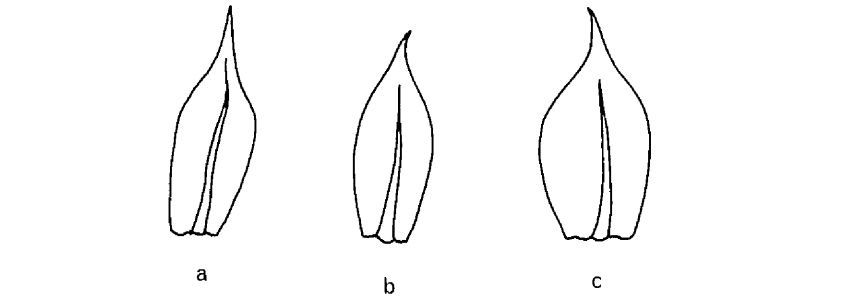
a-d, x15; e-h, x200; i-o, x50.

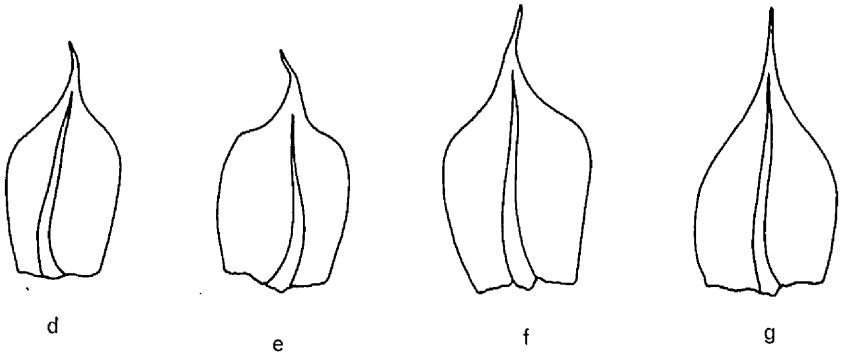


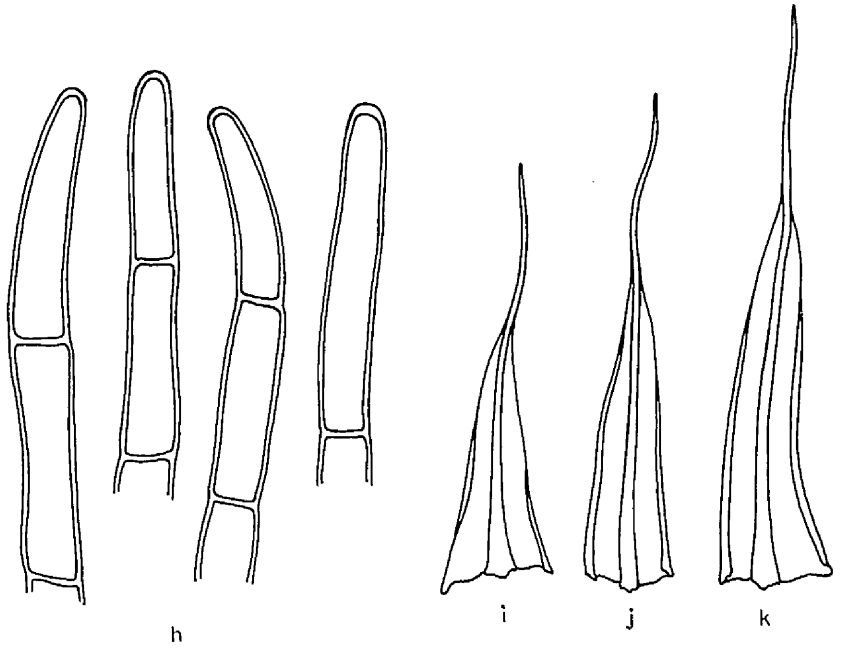
var. capillare.

Fig. 2. B. capillare Hedw. var. capillare, from plant from England. a-g, perigonial leaves; h, tips of male paraphyses; i-k, perichaetial leaves.

a-g, i-k, x15; h, x200.



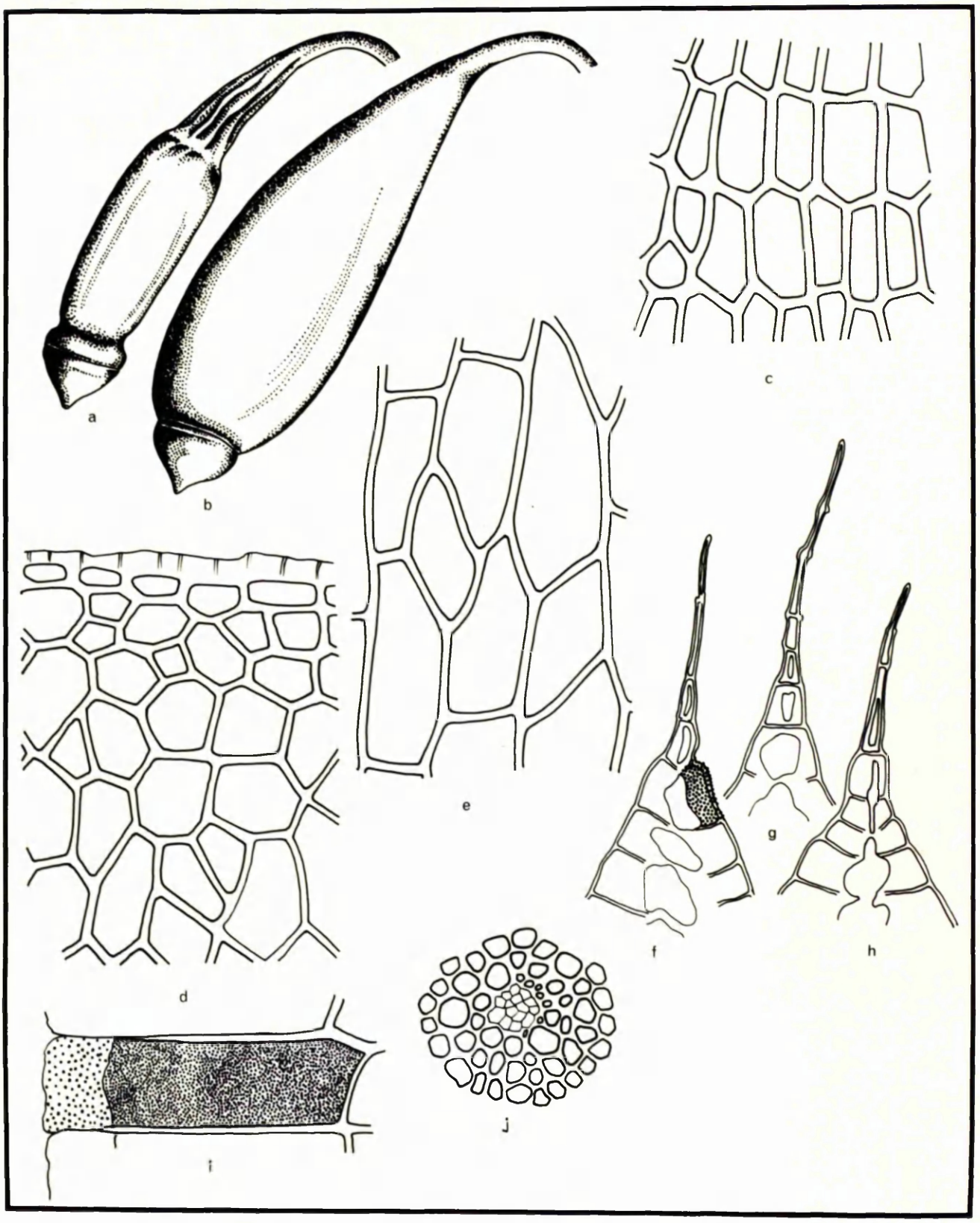




var. capillare

Fig. 3. B. capillare Hedw. var. capillare, from plant from England. a, dry capsule; b, same capsule moist; c, lid cells; d, mouth cells of capsule; e, exothecial cells; f-h, inner peristome teeth; i, part of outer surface of outer peristome; j, cross-section of seta showing central strand and surrounding cells.

a,b, x7.5; c-j, x200.

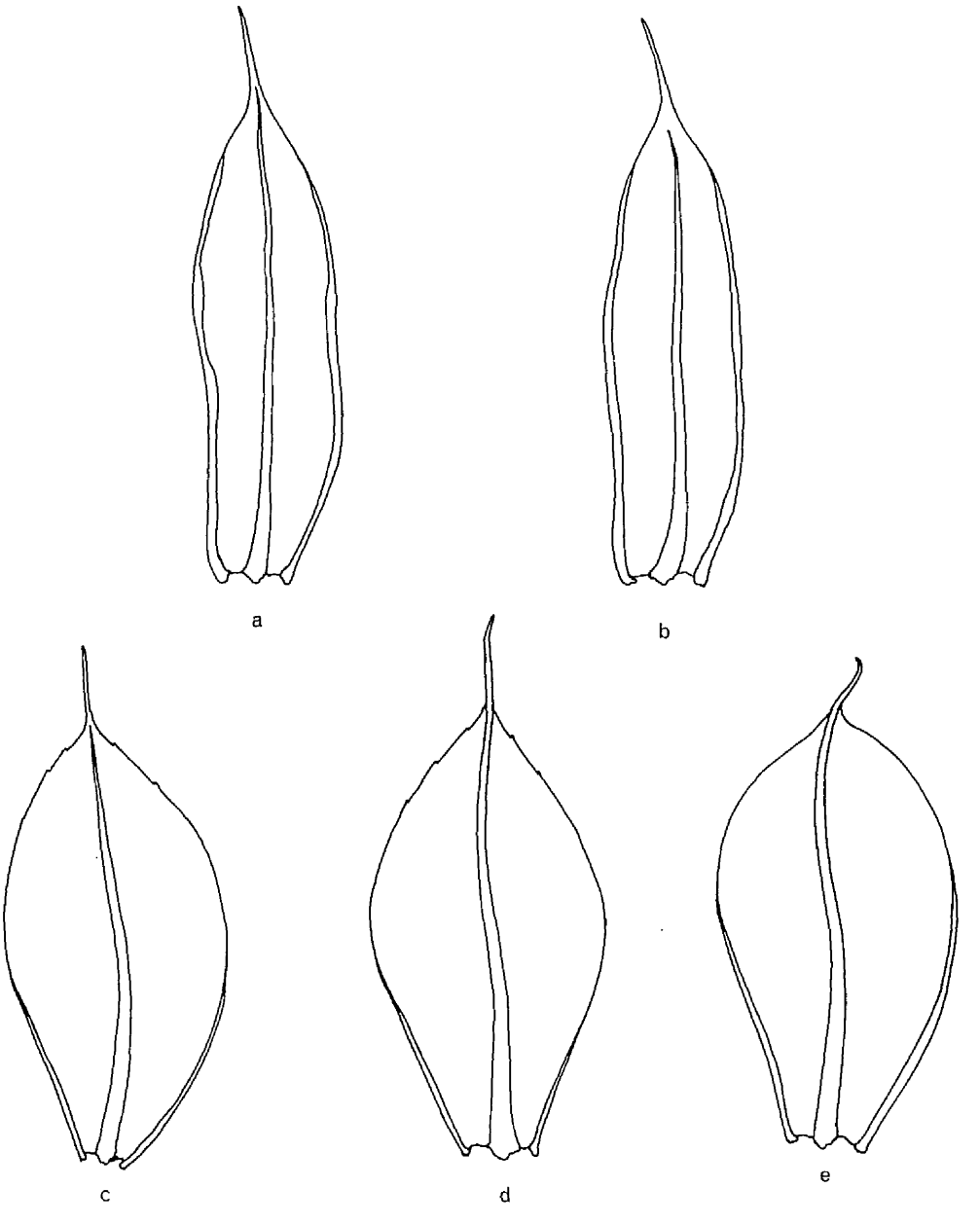


var. capillare

Fig. 4. *B. capillare* Hedw. var. *capillare*,

a,b, from type of *B. baueri* Hamp.; c-e, from plants from England. a-e, leaves.

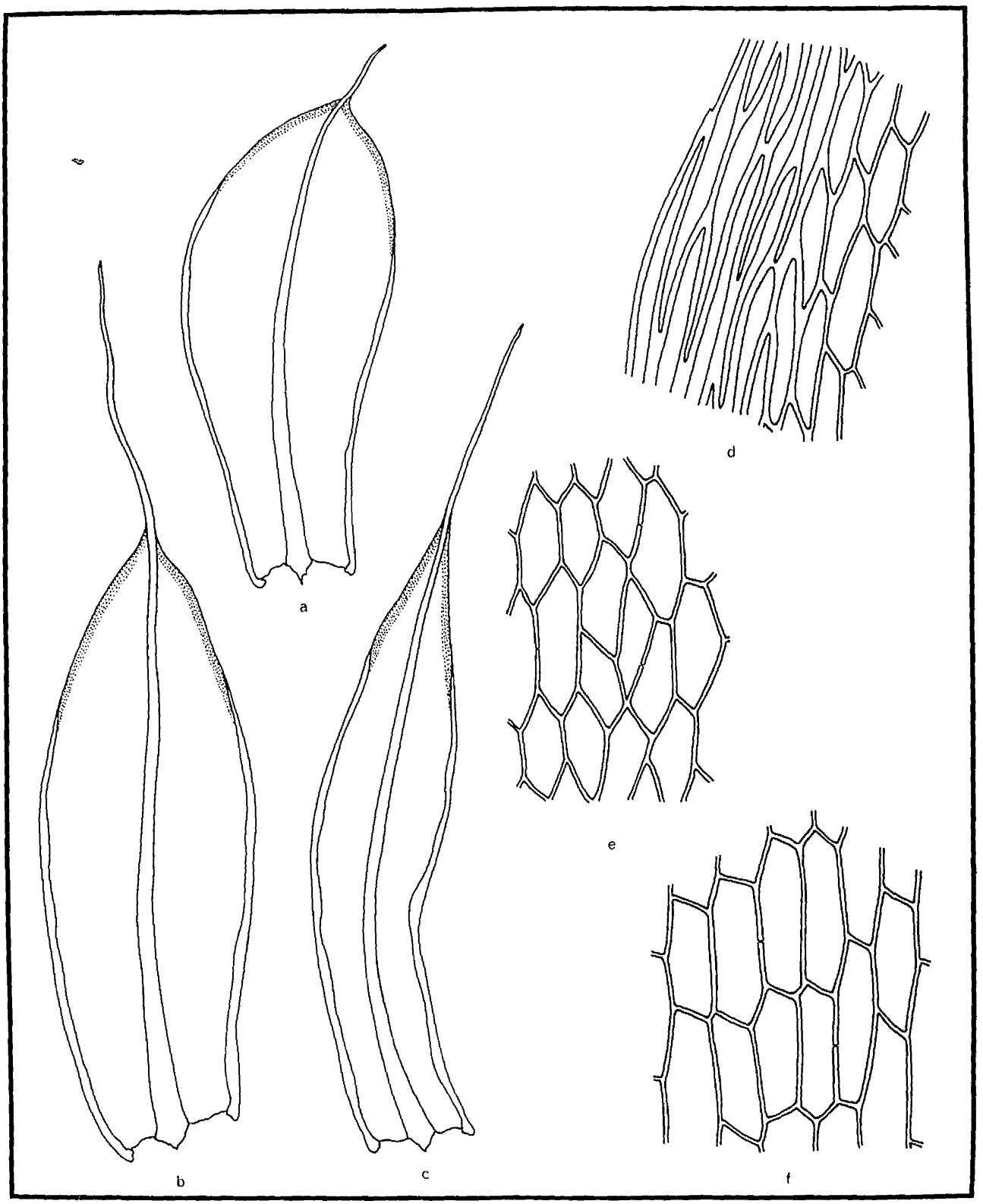
a-e, x15.



var. capillare

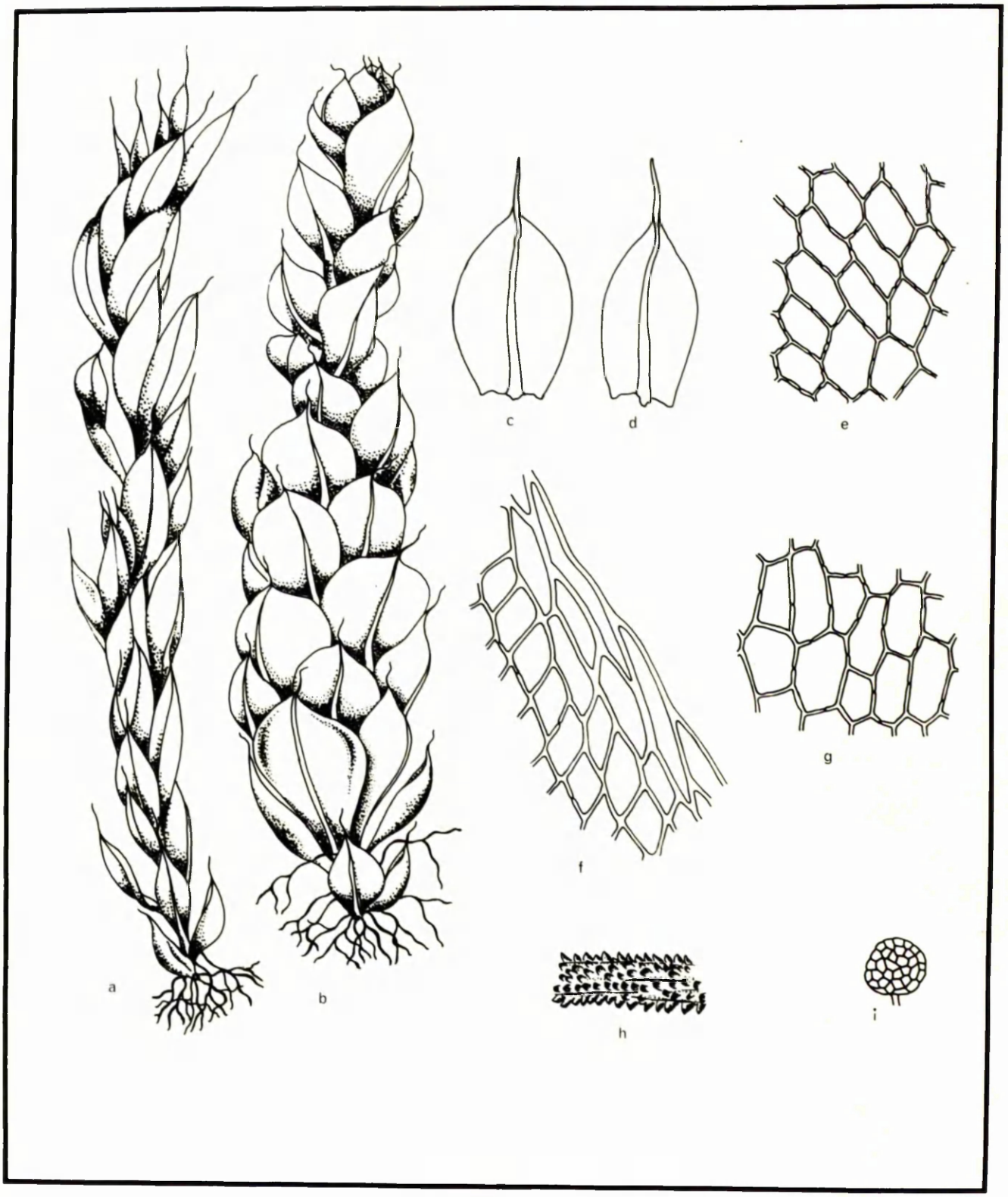
Fig. 5. B. capillare Hedw. var. rufifolium (Dix.) Podp.; from plant from Scotland. a-c, leaves; d, cells at margin of leaf; e, cells in middle; f, cells at base.

a-c, x15; d-f, x200.



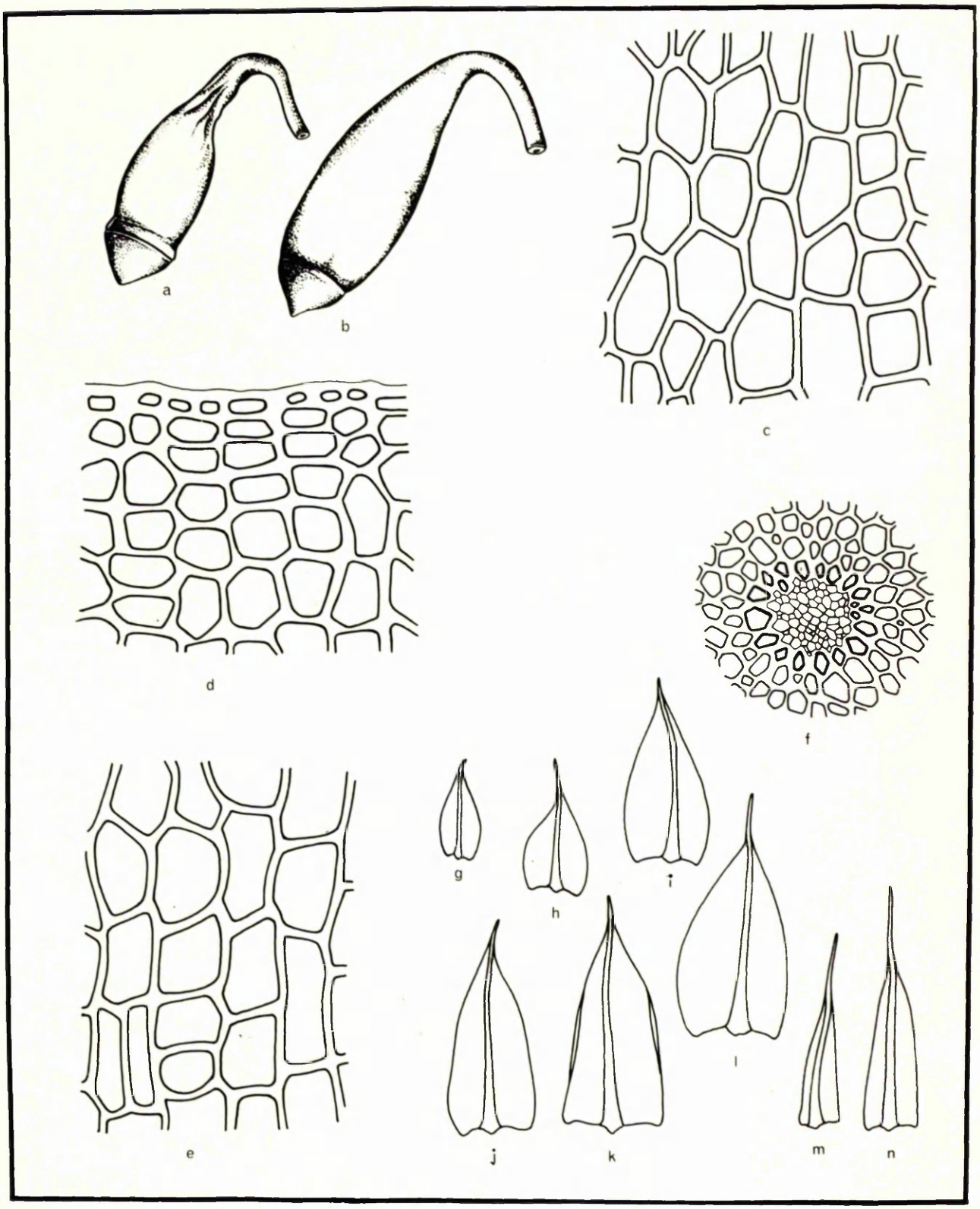
var. rufifolium

Fig. 6. B. elegans Nees ex Brid., from plant from Switzerland.
a,b, plants dry; c,d, leaves; e, cells in middle of leaf;
f, cells at margin; g, cells at base; h, a portion of rhizoid;
i, tuber.
a-d, x15; e-h, x200; i, x50.



B. elegans

Fig. 7. *B. elegans* Nees ex Brid., from plant from Switzerland. a, dry capsule; b, same capsule moist; c, lid cells; d, cells at mouth of capsule; e, exothecial cells; f, cross-section of seta showing central strand and surrounding cells; g-l, perigonial leaves; m,n, perichaetial leaves. a,b, x7.5; c-f, x200; g-n, x15.

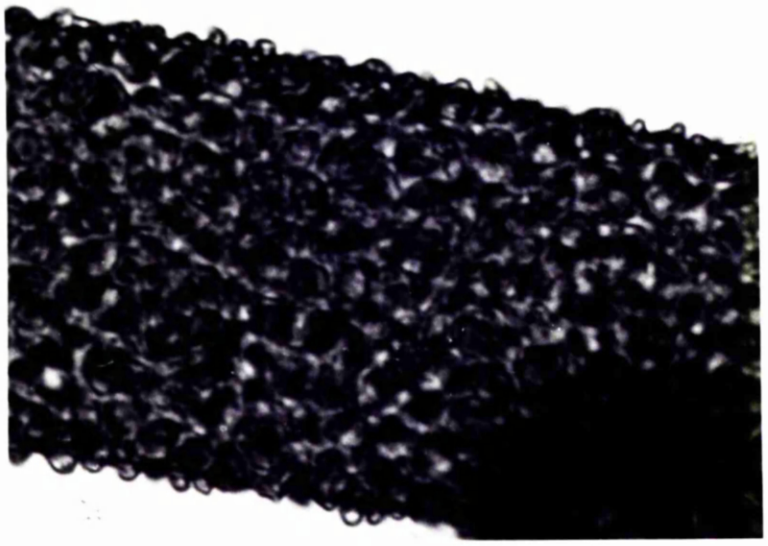


B. elegans

Fig. 8. Photographs showing papillae on the rhizoids of a, B. capillare; b, B. elegans.

a, b, x2,500.

a



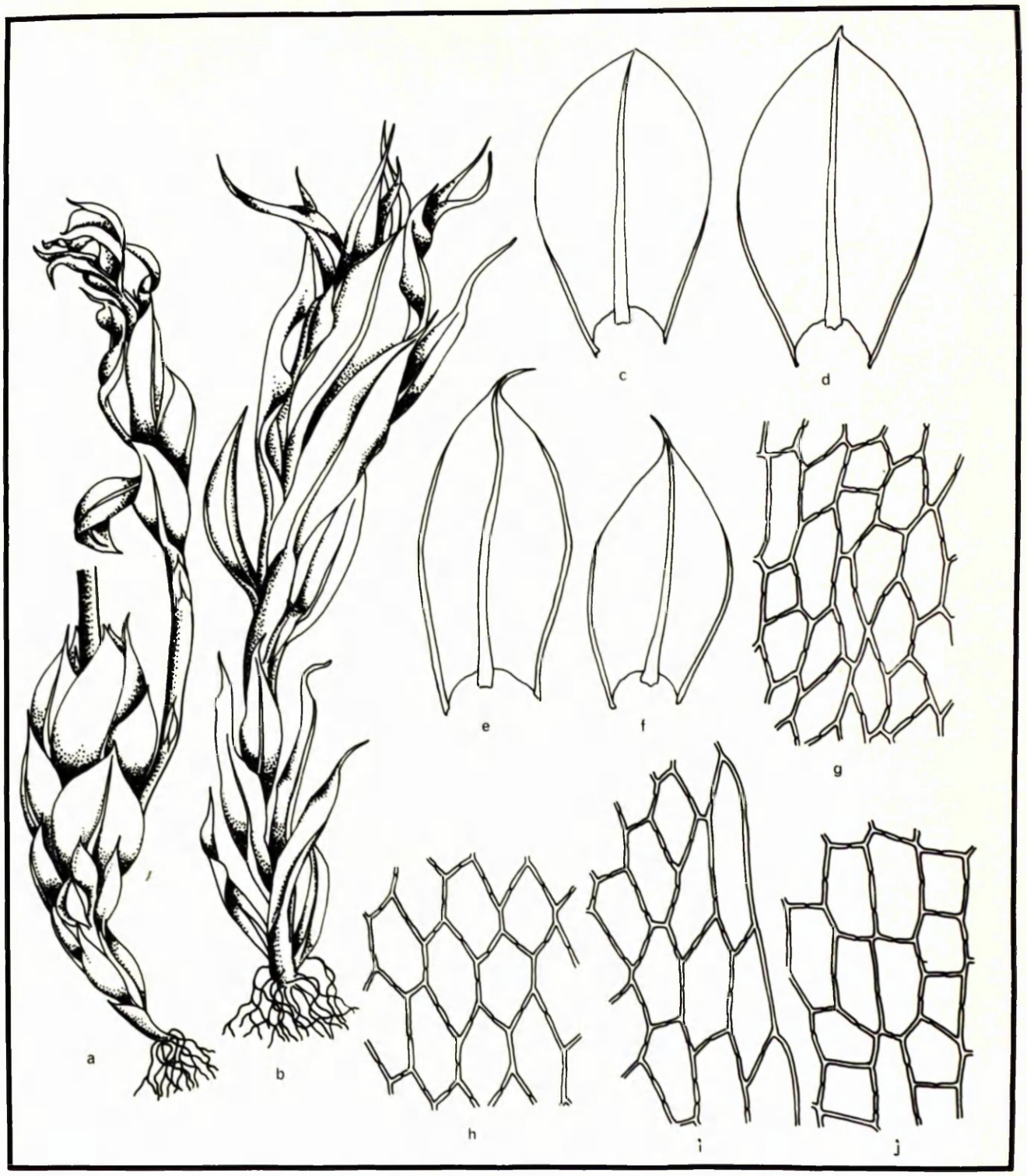
B.capillare

b

B. elegans

Fig. 9. B. stirtonii Schimp., from plant from Gästrikland. a,b, plants dry; c-f, leaves; g,h, cells in middle of leaf; i, cells at margin; j, cells at base.

a-f, x15; g-j, x200.



B. stirtonii

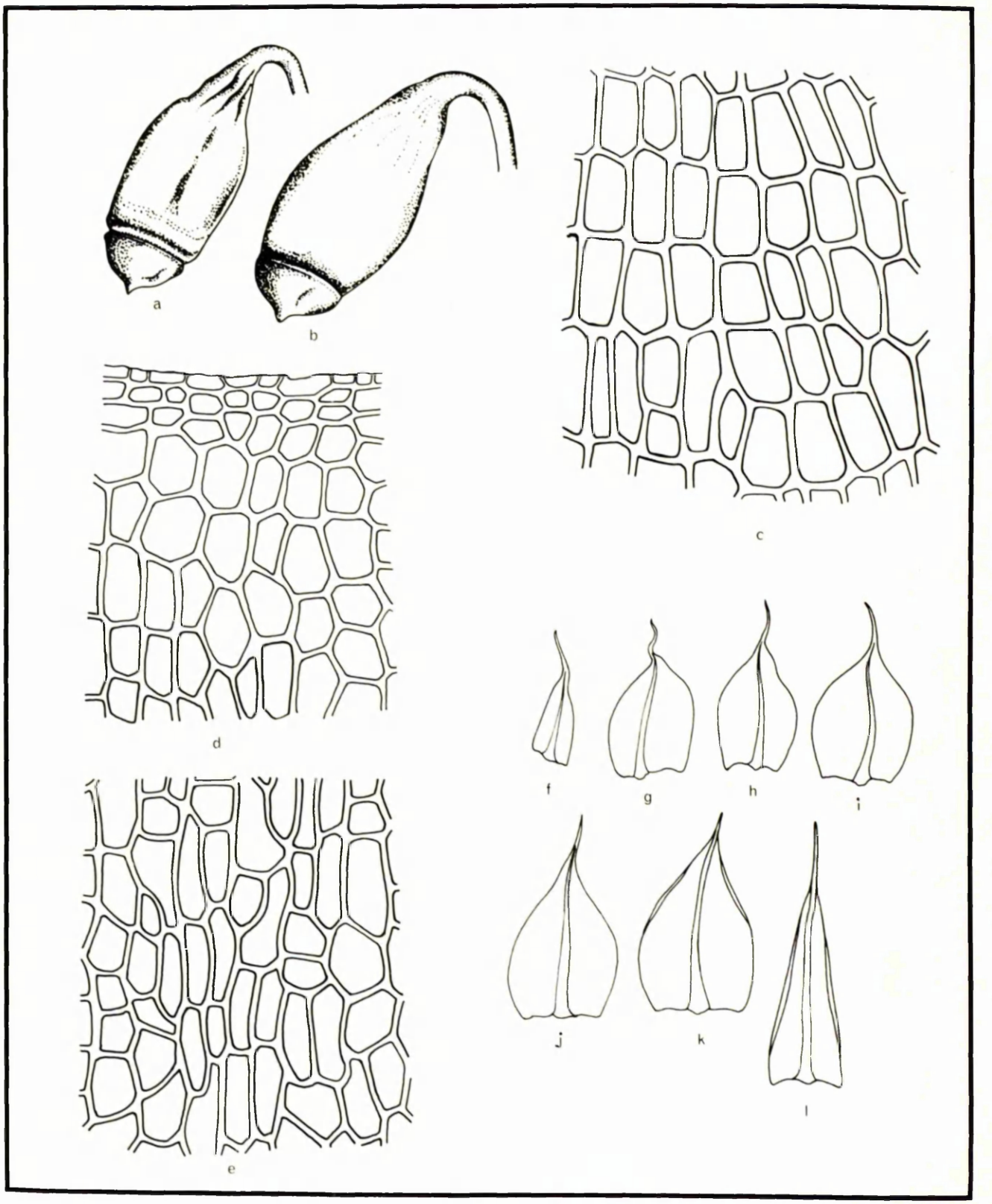
Fig. 10. B. stirtonii Schimp., from plant from Gästrikland.

a, dry capsule; b, same capsule moist; c, lid cells;

d, cells at mouth of capsule; e, exothecial cells;

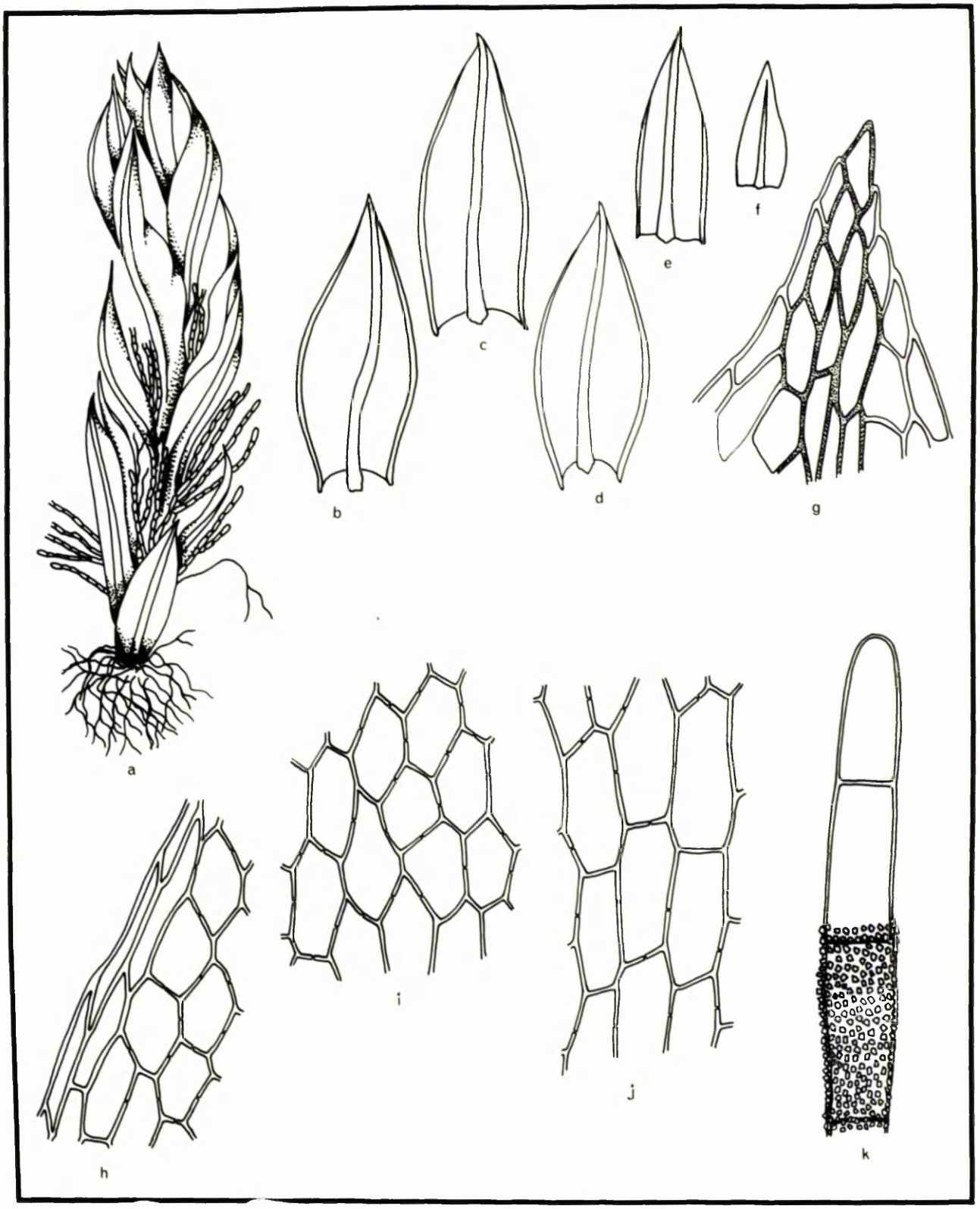
f-k, perigonial leaves; l, perichaetial leaf.

a,b, x7.5; c-e, x200; f-l. x15.



B. stirtonii

Fig. 11. B. subelegans Kindb., from plant from Bohuslän.
a, plant dry; b-d, leaves; e,f, perichaetial leaves;
g, cells at the tip of leaf; h, cells at margin;
i, cells in middle; j, cells at base; k, axillary gemma.
a-f, x15; g-k, x200.

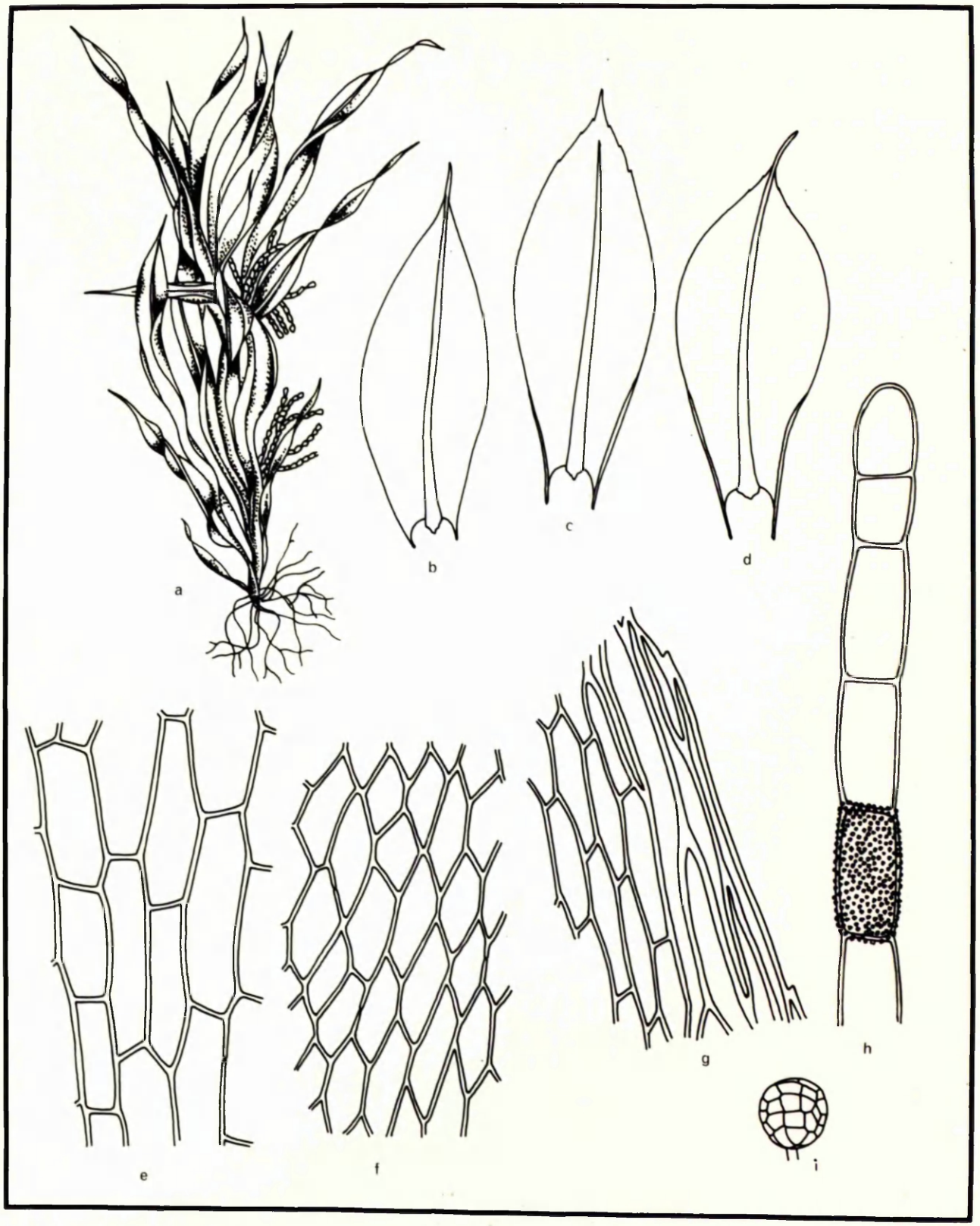


B. subelegans

Fig. 12. B. flaccidum Brid., from plant from Austria.

a, plant dry; b-d, leaves; e, cells at base of leaf; f, cells in middle; g, cells at margin; h, axillary gemma; i, tuber.

a-d, x15; e-h, x200; i, x50.

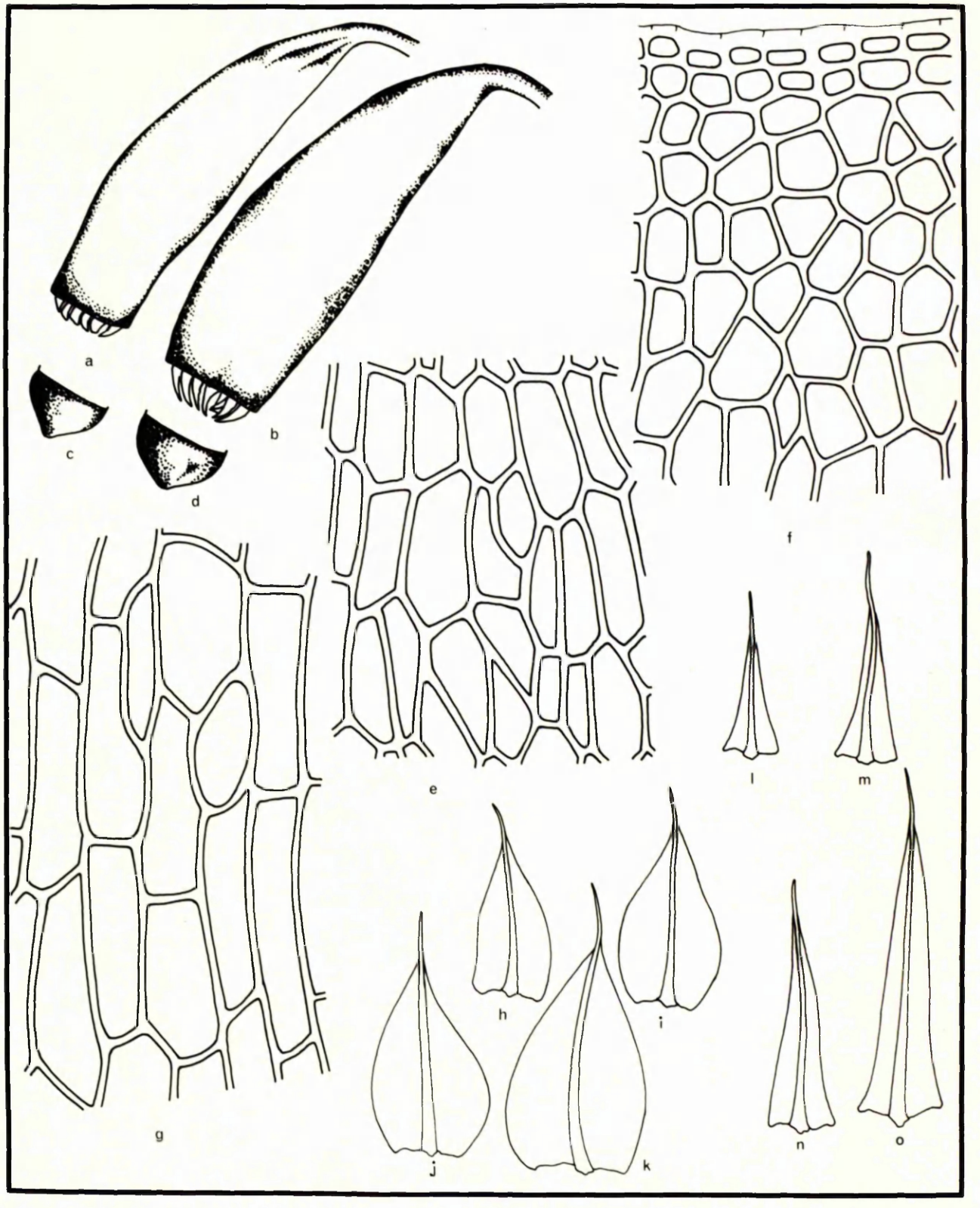


B. flaccidum

Fig. 13. B. flaccidum Brid., from plant from Austria.

a, dry capsule; b, same capsule moist; c, dry lid; d, same lid moist; e, lid cells; f, cells at mouth of capsule; g, exothecial cells; h-k, perigonial leaves; l-o, perichaetial leaves.

a-d, x7.5; e-g, x200; h-o, x15.



B. flaccidum

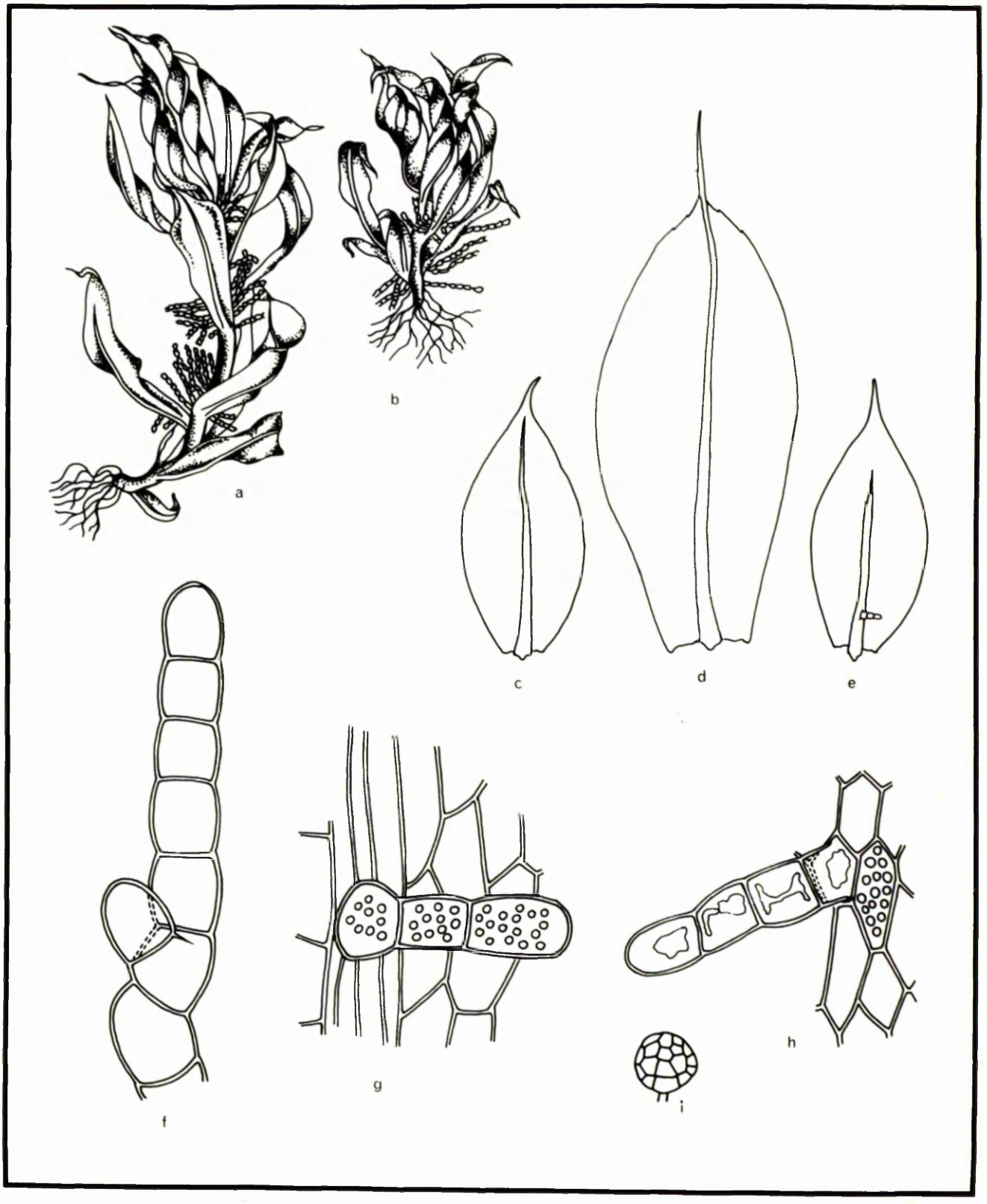
Fig. 14. B. laevifilum Syed, from plant from Hungary.

a,b, plants dry; c-e, leaves; f, axillary gemma;

g, gemma on midrib; h, gemma on leaf blade;

i, tuber.

a-e, x15; f-h, x200; i, x50.



B. laevifilum

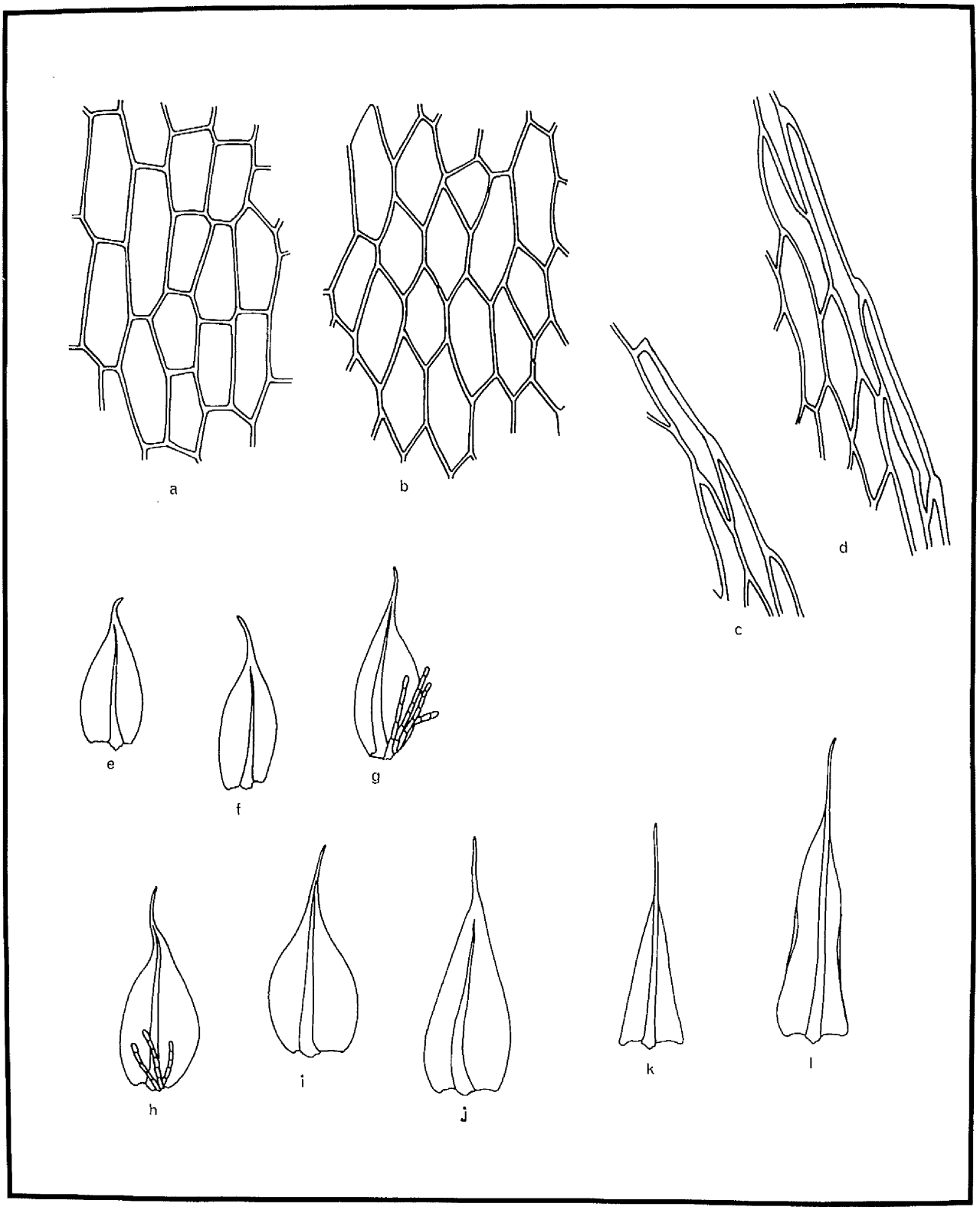
Fig. 15. B. laevifilum Syed, from plant from Hungary.

a, cells at base of leaf; b, cells in middle;

c,d, cells at margin; e-j, perigonial leaves;

k,l, perichaetial leaves.

a-d, x200; e-l, x15.



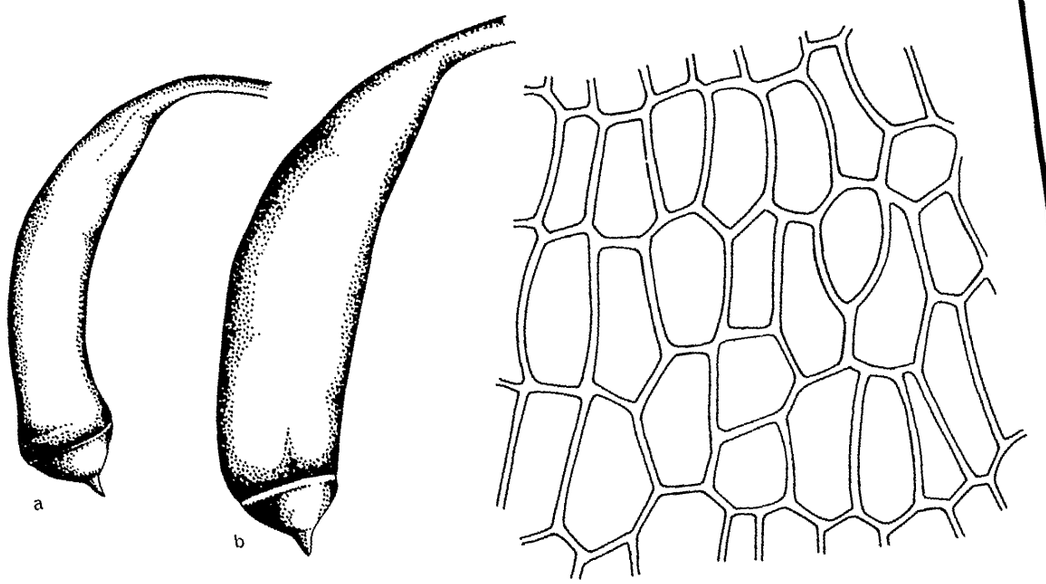
B. laevifilum

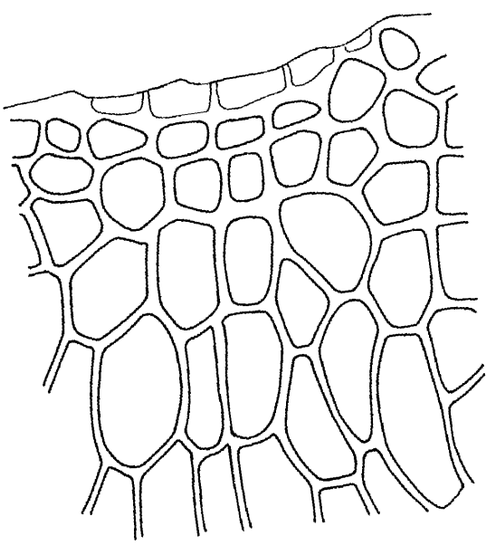
Fig. 16. B. laevifilum Syed, from plant from Hungary.

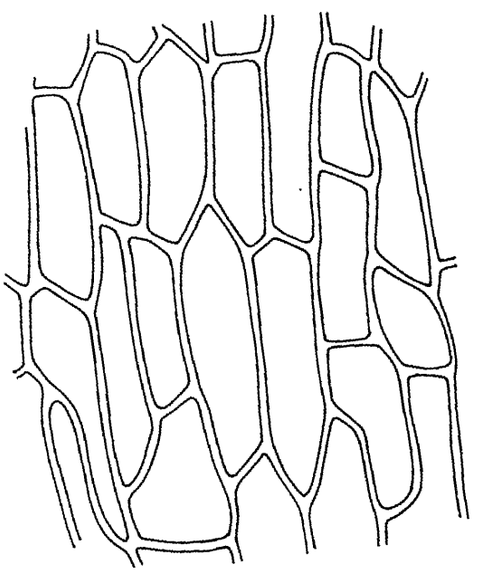
a, dry capsule; b, same capsule moist; c, lid cells;

d, cells at mouth of capsule; e, exothecial cells.

a,b, x7.5; c-e, x200.

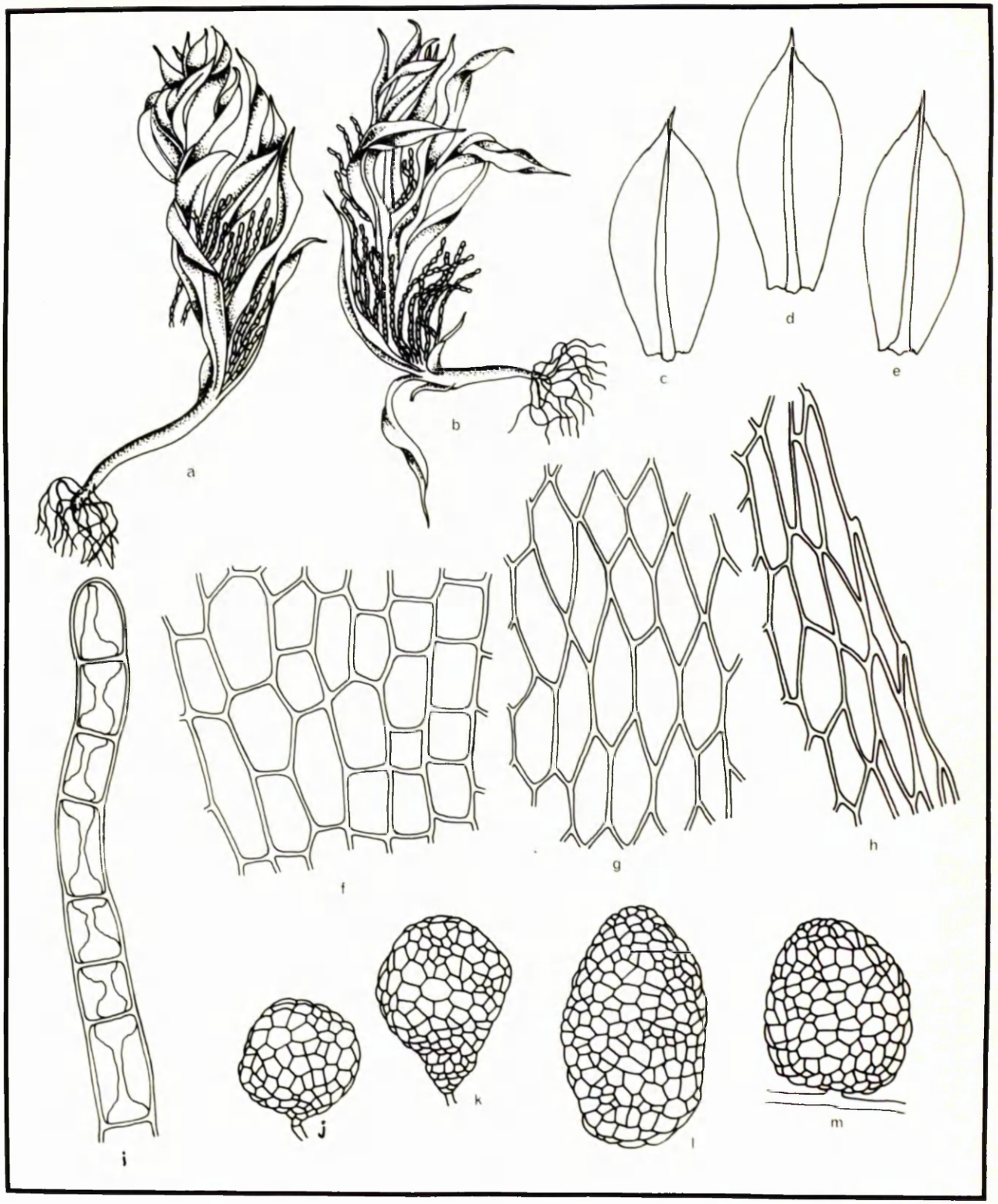






B. laevifilum

Fig. 17. B. pseudocapillare Besch., from plant from Florida.
a,b, plants dry; c-e, leaves; f, cells at base of leaf;
g, cells in middle; h, cells at margin; i, axillary gemma,
j-m, tubers.
a-e, x15; f-i, x200; j-m, x50.



B. pseudocapillare

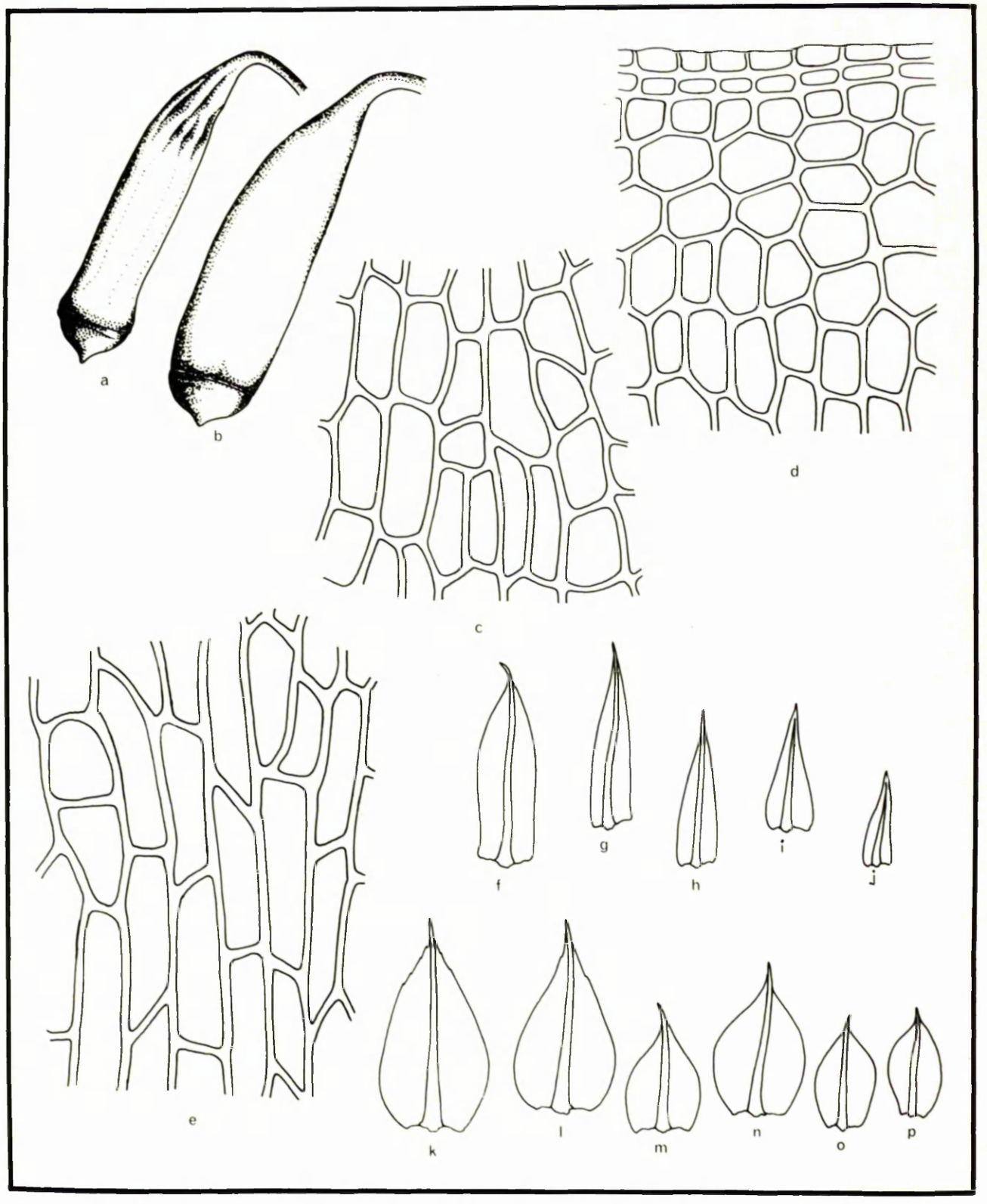
Fig. 18. B. pseudocapillare Besch., from plant from Florida.

a, dry capsule; b, same capsule moist; c, lid cells;

d, cells at mouth of capsule; e, exothecial cells;

f-j, perichaetial leaves; k-p, perigonial leaves.

a,b, x7.5; c-e, x200; f-p, x15.

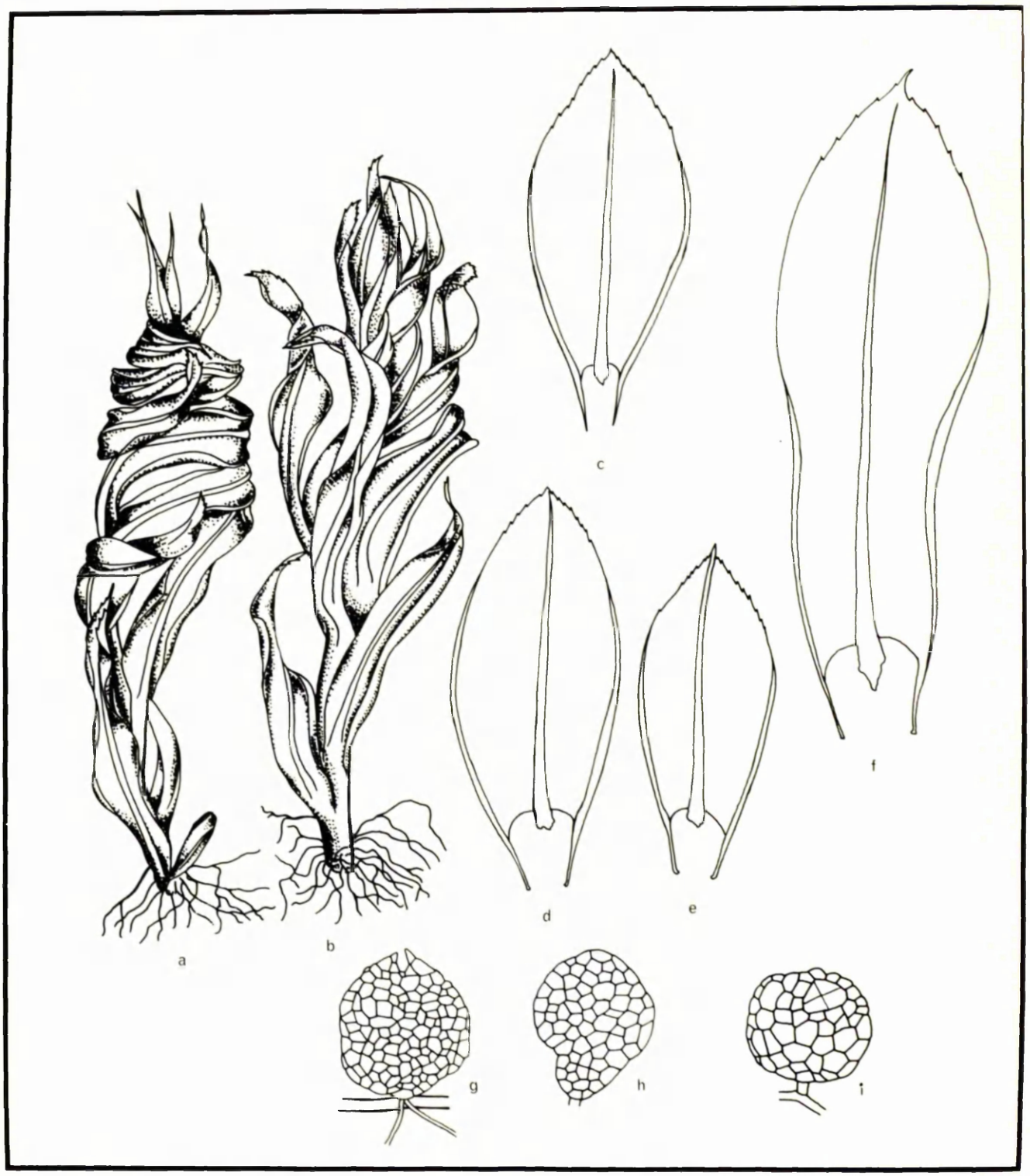


B. pseudocapillare

Fig. 19. B. erythroloma Kindb., from plant from Vancouver.

a,b, plants dry; c-f, leaves; g-i, tubers.

a-f, x15; g-i, x50.



B. erythroloma

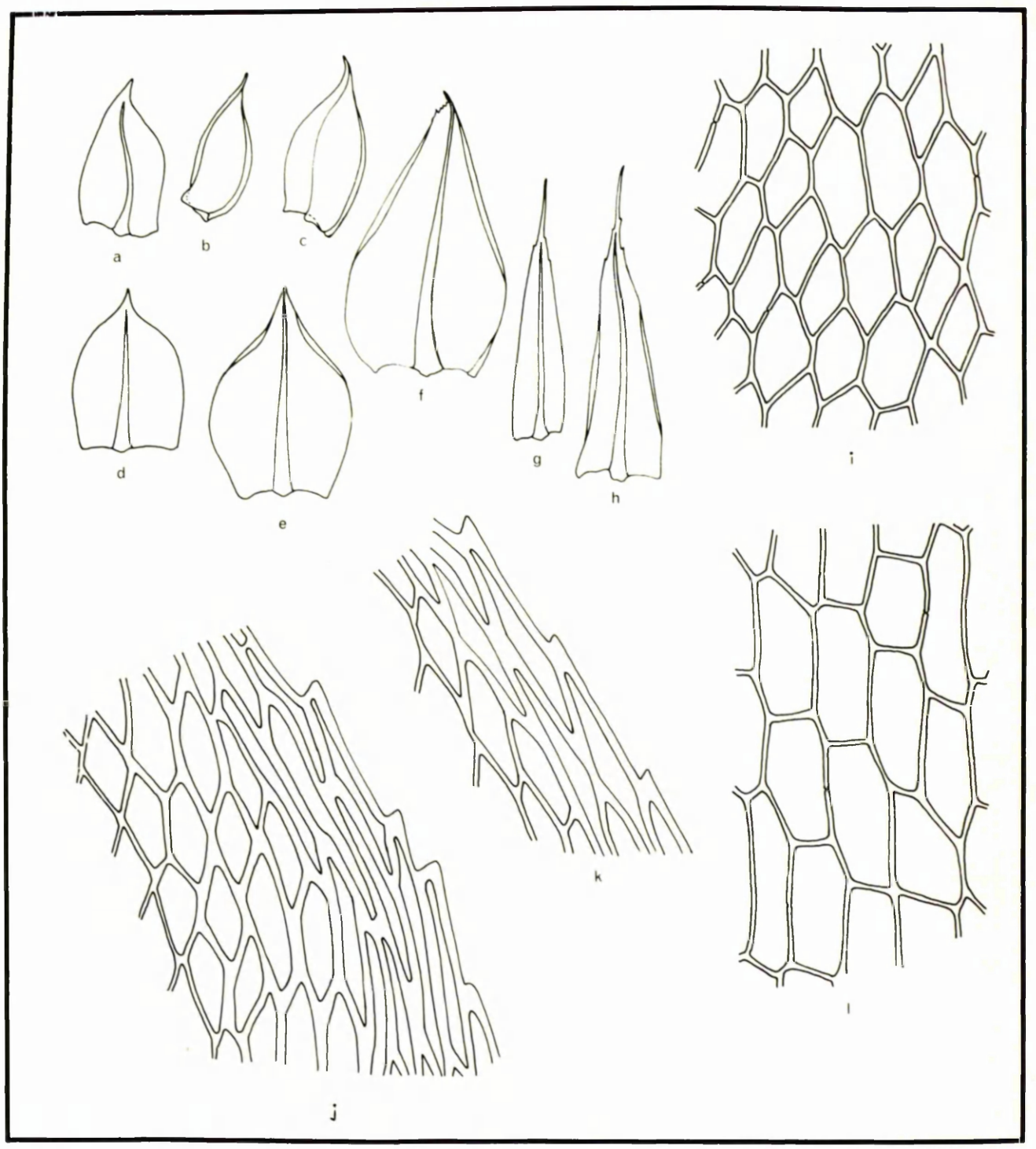
Fig. 20. B. erythroloma Kindb., from plant from Vancouver.

a-f, perigonial leaves; g,h, perichaetial leaves;

i, cells in middle of leaf; j,k, cells at margin;

l, cells at base.

a-h, x15; i-l, x200.



B. erythroloma

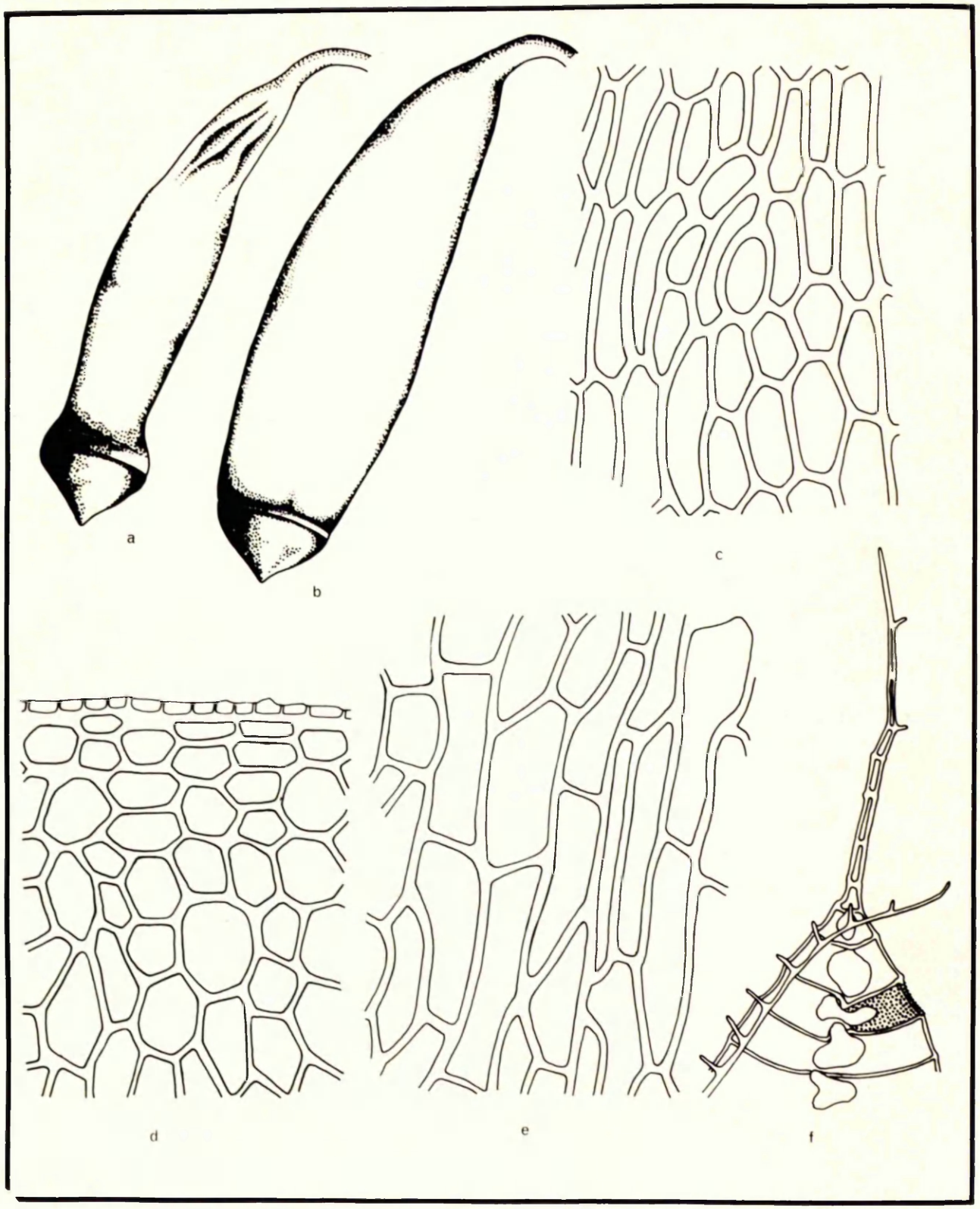
Fig. 21. B. erythroloma Kindb., from plant from Vancouver.

a, dry capsule; b, same capsule moist; c, lid cells;

d, cells at mouth of capsule; e, exothecial cells;

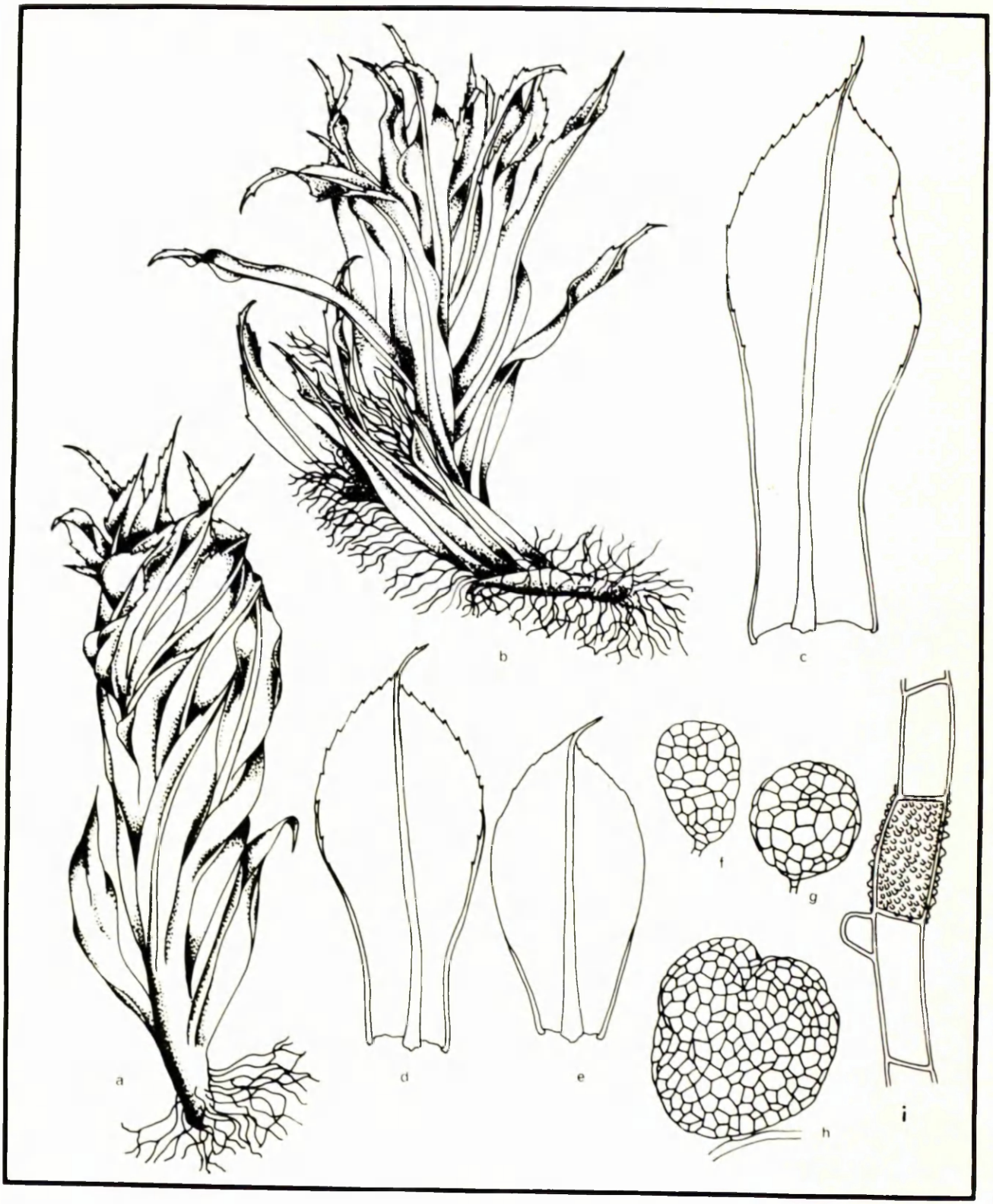
f, tip of inner peristome tooth.

a,b, x7.5; c-f, x200.



B. erythroloma

Fig. 22. B. albo-limbatum Hamp., a-d, f-i, from the type of B. albo-limbatum, e, from the type of B. pusillum Broth. a,b, plants dry; c-e, leaves; f-h, tubers; i, axillary gemma. a-e, x15; f-h, x50; i, x200.



B. albo-limbatum

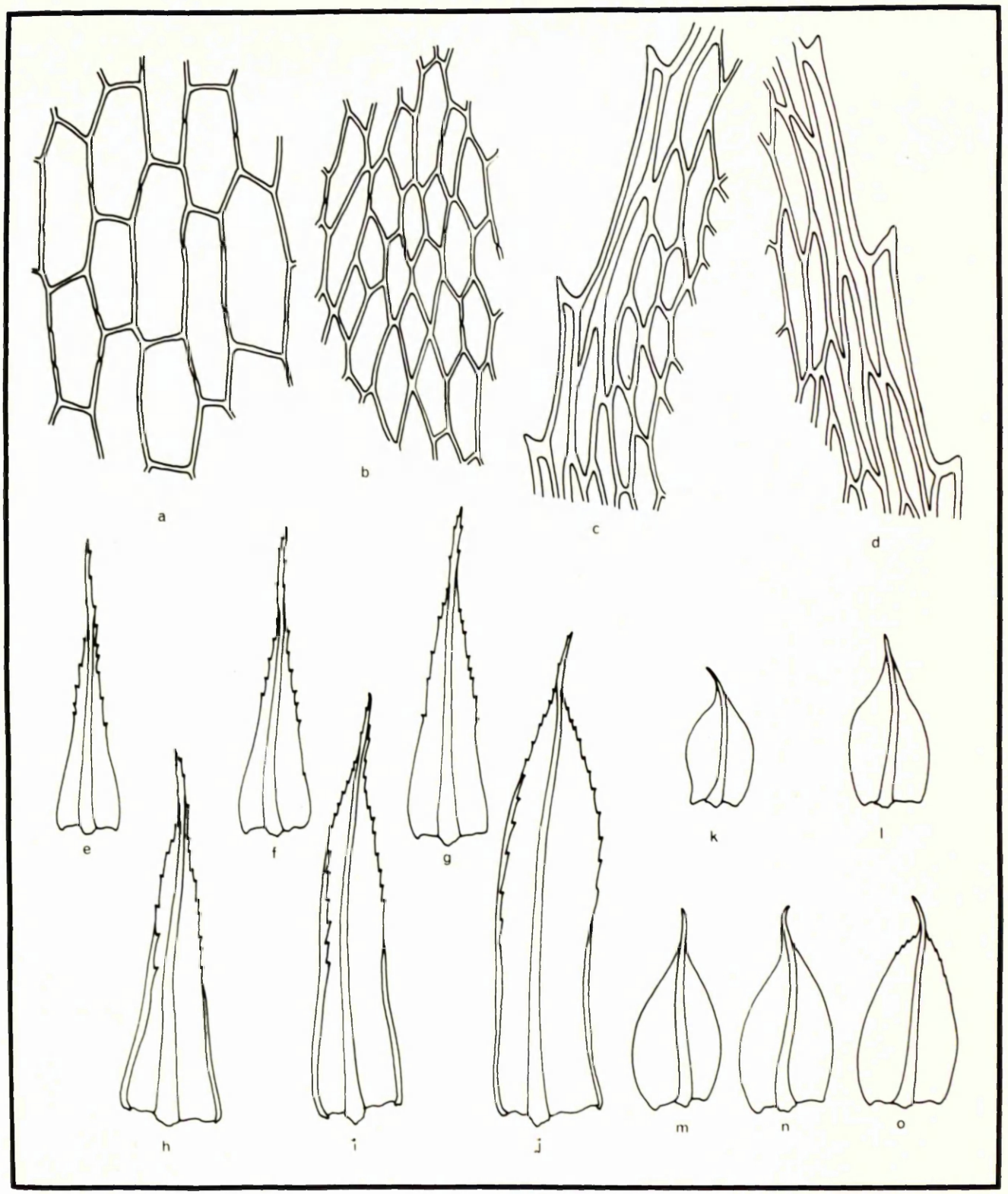
Fig. 23. B. albo-limbatum Hamp., from the type.

a, cells at base of leaf; b, cells in middle;

c,d, cells at margin; e-j, perichaetial leaves;

k-o, perigonial leaves.

a-d, x200; e-o, x15.



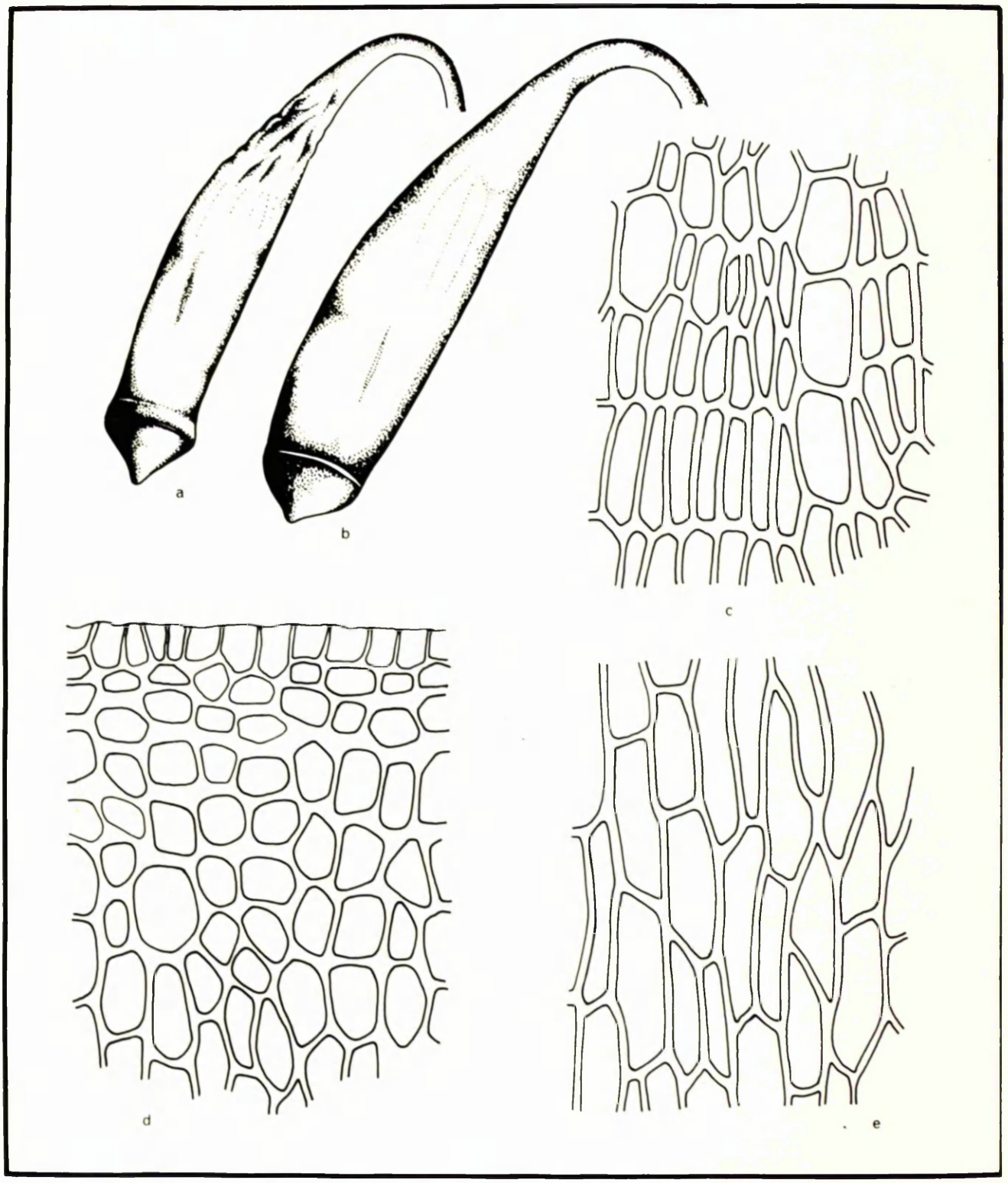
B. albo-limbatum

Fig. 24. B. albo-limbatum Hamp., from the type.

a, dry capsule; b, same capsule moist; c, lid cells;

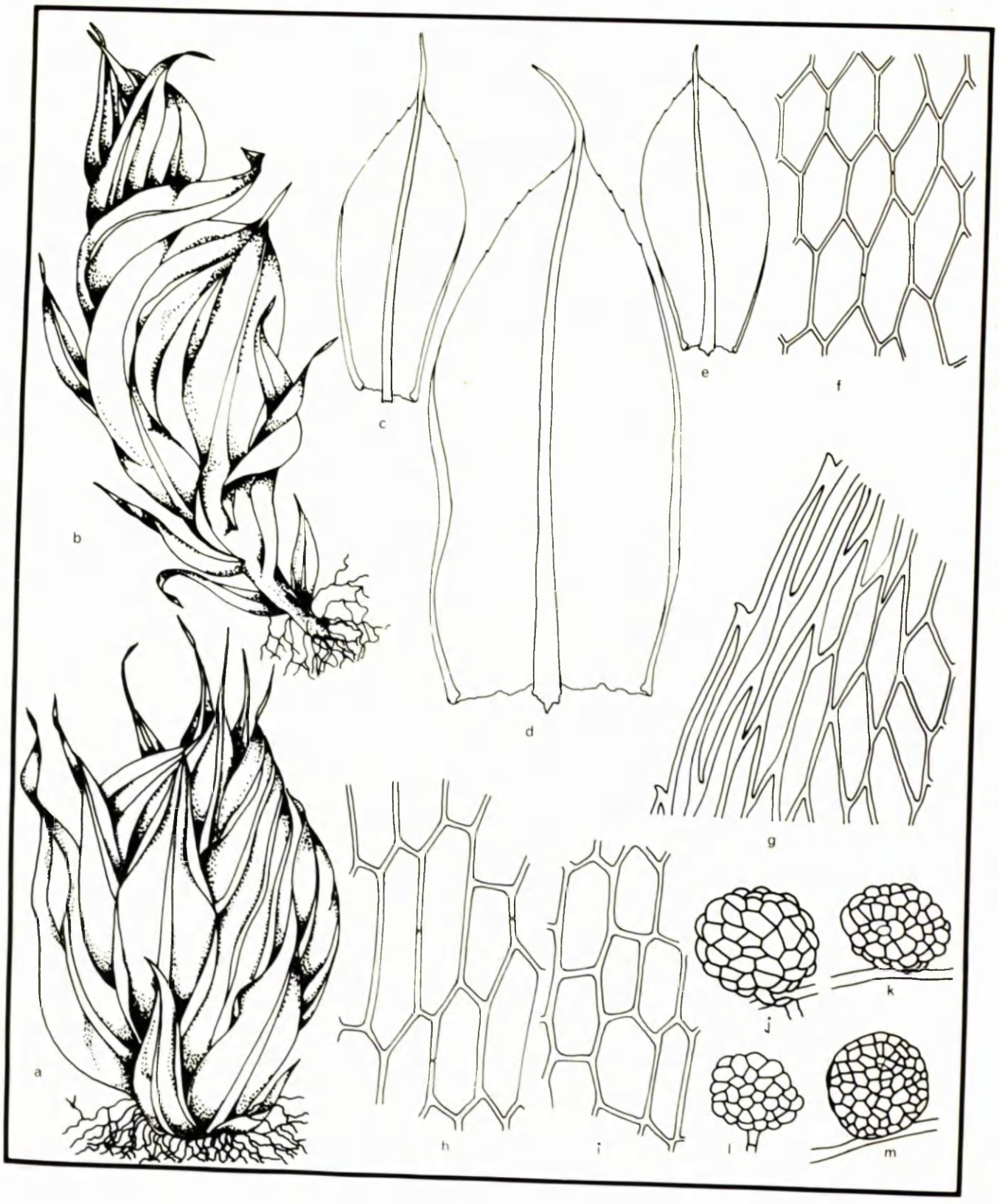
d, cells at mouth of capsule; e, exothecial cells.

a,b, x7.5; c-e, x200.



B. albo-limbatum

Fig. 25. B. torquescens Bruch., from plant from England. a,b, plants dry; c-e, leaves; f, cells in middle of leaf; g, cells at margin; h,i, cells at base; j-m, tubers. a-e, x15; f-i, x200; j-m, x50.



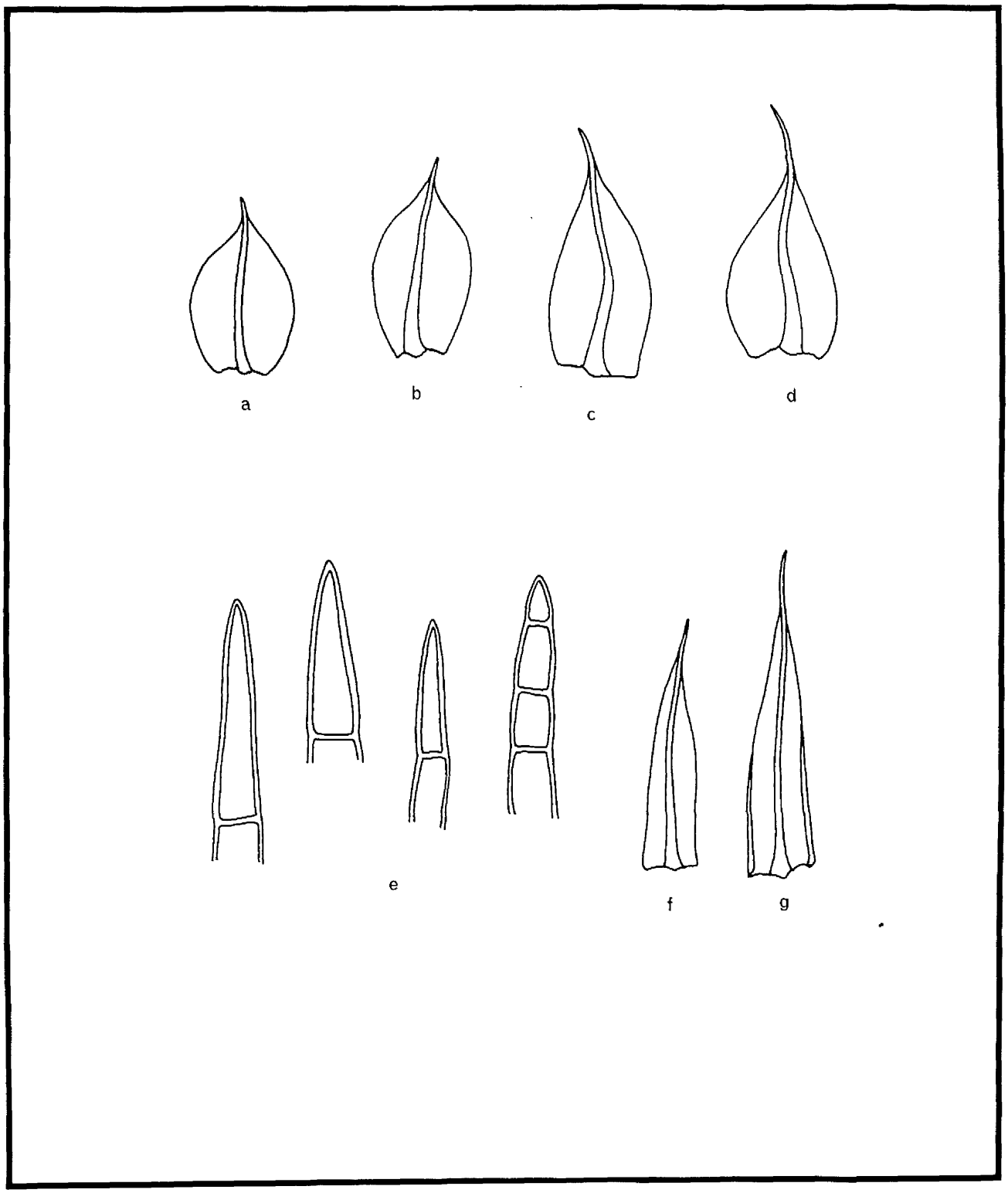
B. torquescens

Fig. 26. B. torquescens Bruch., from plant from England.

a-d, perigonial leaves; e, tips of male paraphyses;

f,g, perichaetial leaves.

a-d, f, g, x15; e, x200.



B. torquescens

Fig. 27. B. torquescens Bruch., from plant from England.

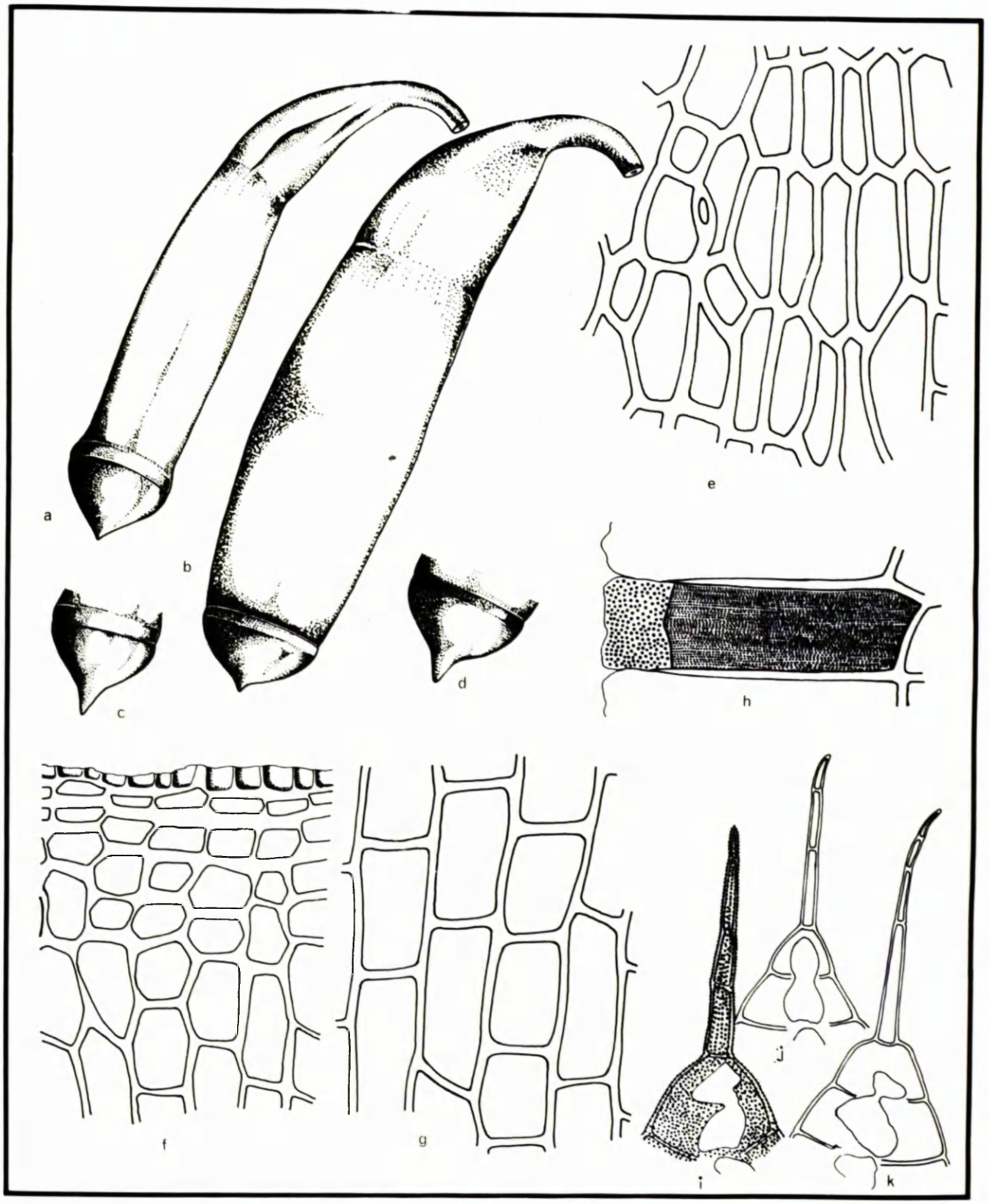
a, dry capsule; b, same capsule moist; c, dry lid;

d, same lid moist; e, lid cells; f, cells at mouth of capsule;

g, exothecial cells; h, outer surface of outer peristome;

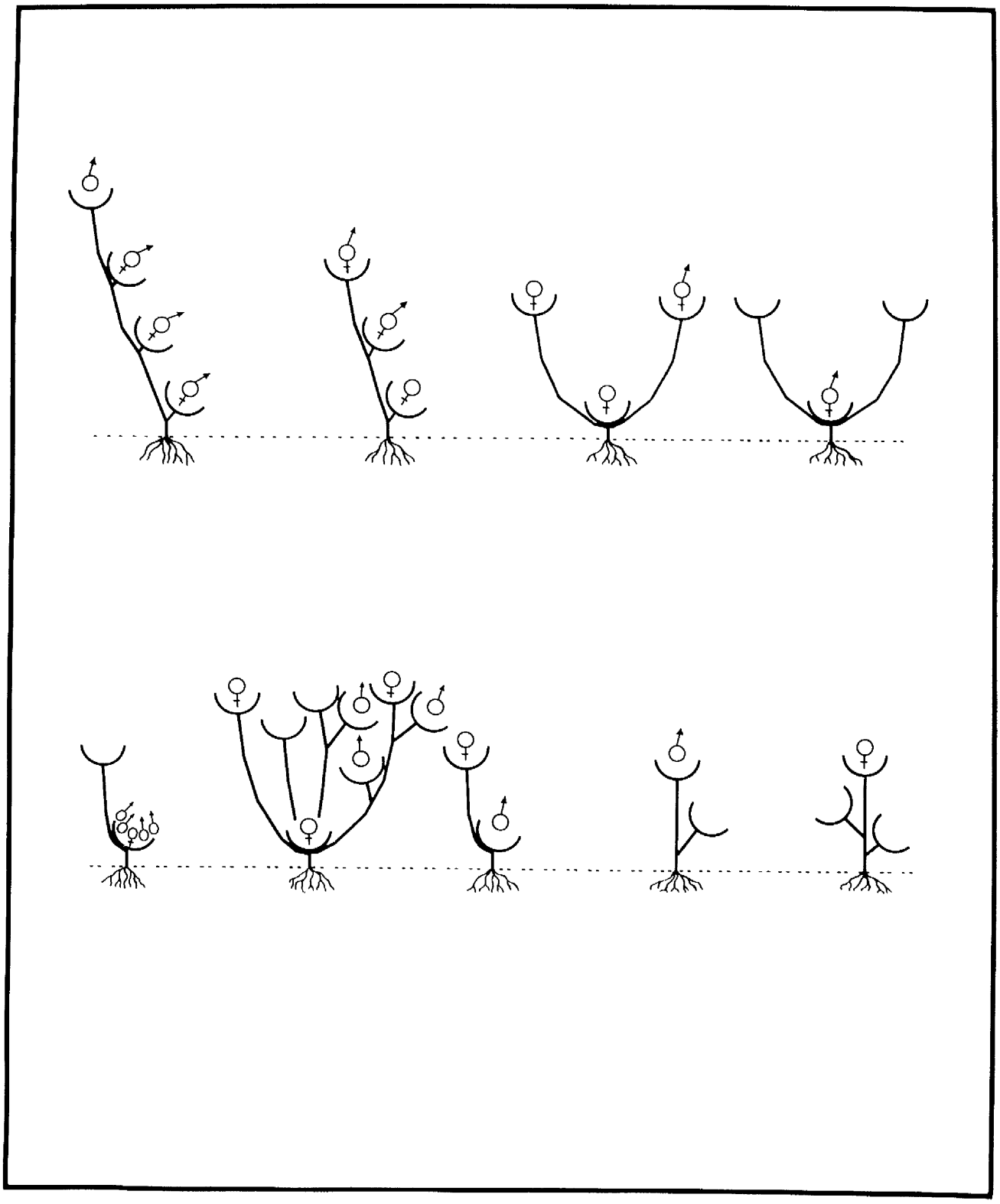
i-k, inner peristome teeth.

a-d, x7.5; e-k, x200.



B. torquescens

Fig. 28. Diagrammatic presentation of the types and arrangements of inflorescence in Bryum torquescens Bruch.



B. torquescens

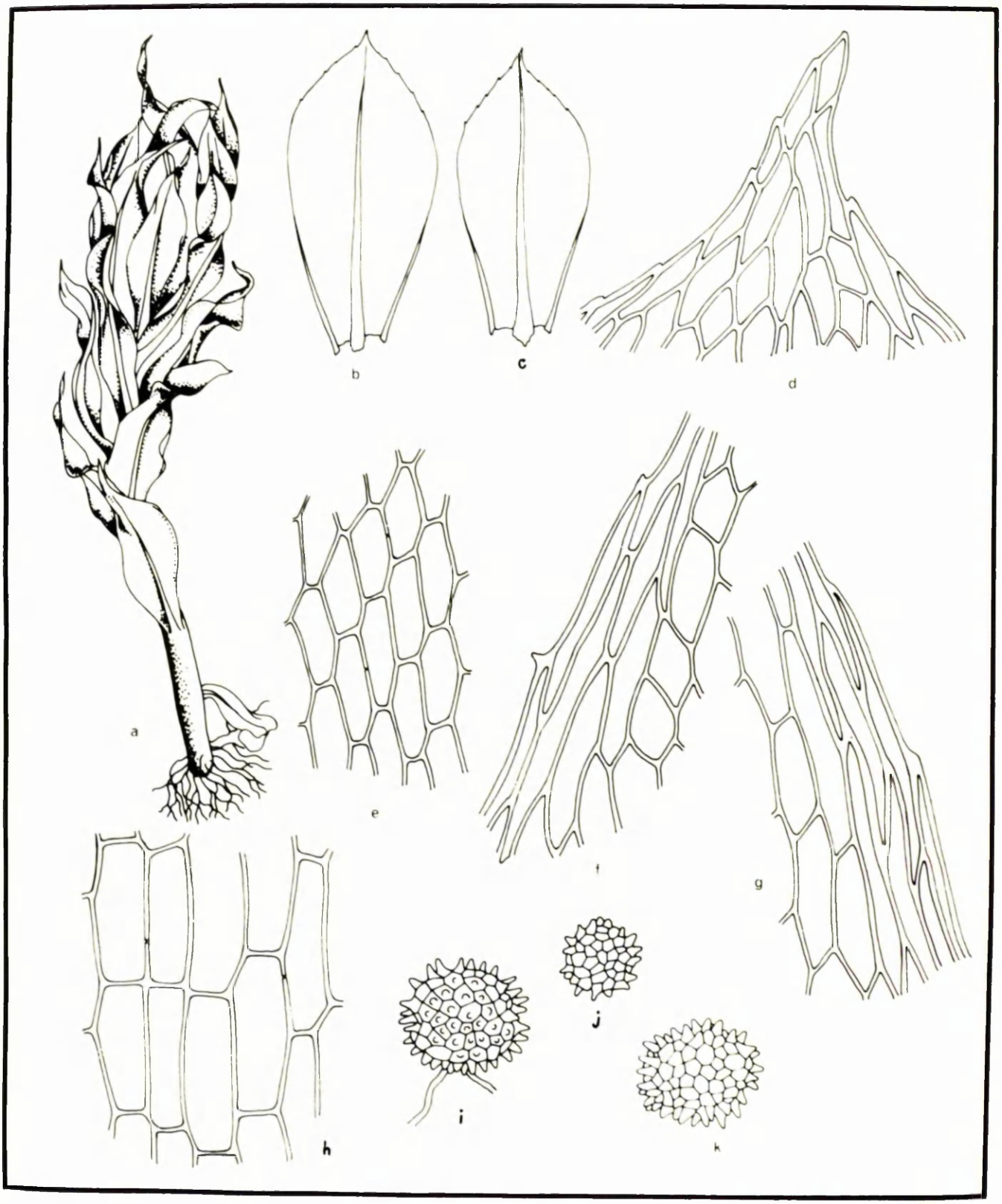
Fig. 29. B. jamaicanse Syed, from plant from Jamaica.

a, plant dry; b,c, leaves; d, cells at tip of leaf;

e, cells in middle; f,g, cells at margins; h, cells at base;

i-k, tubers.

a-c, x15; d-h, x200; i-k, x50.



B. jamaicanse

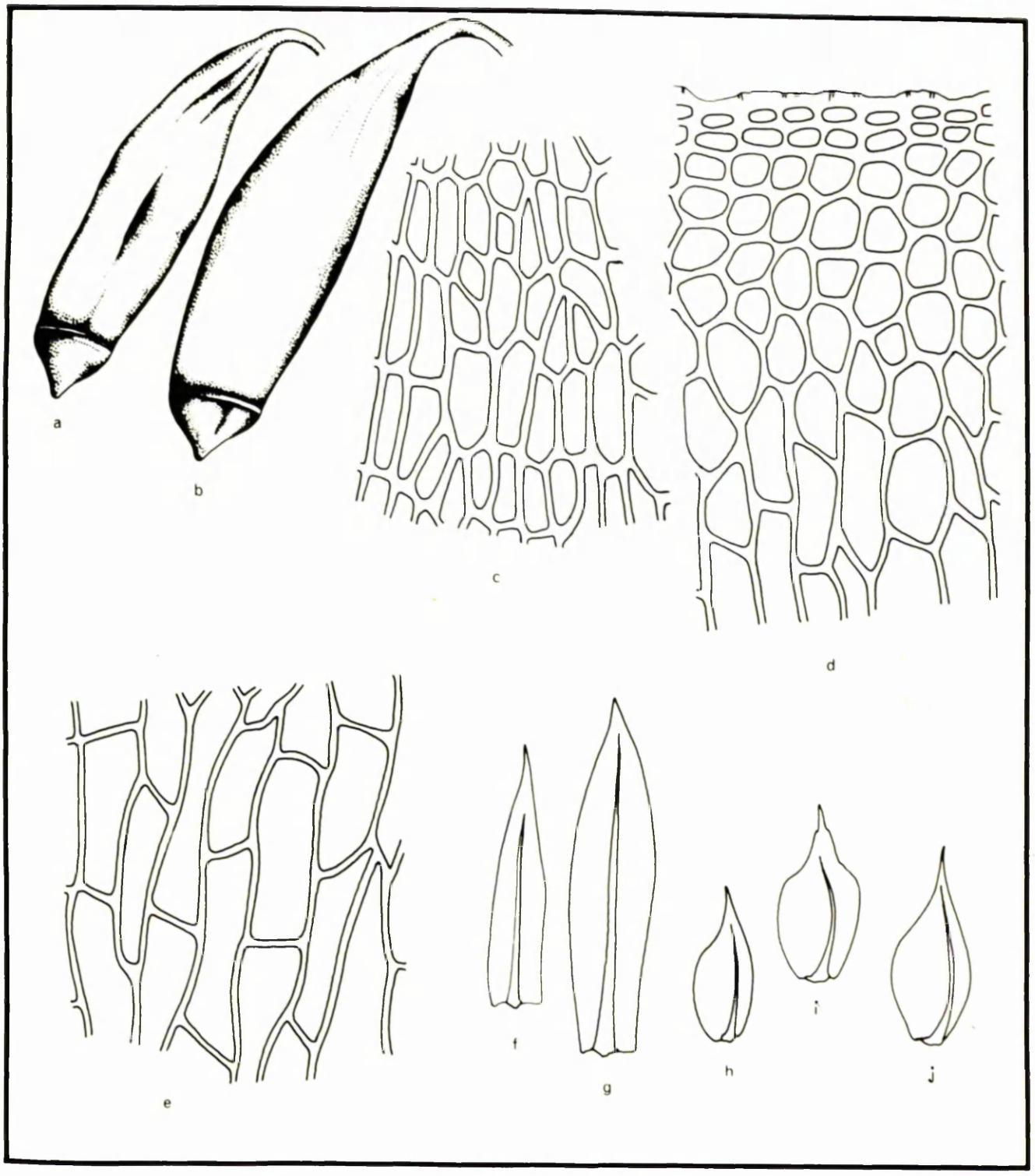
Fig. 30. B. jamaicanse Syed, from plant from Jamaica.

a, dry capsule; b, same capsule moist; c, lid cells;

d, cells at mouth of capsule; e, exothecial cells;

f,g, perichaetial leaves; h-j, perigonial leaves.

a,b, x7.5; c-e, x200; f-j, x15.



B. jamaicanse

Fig. 31. Scanning Electron micrographs showing the ornamentations on the outer surface of the spore walls.

a,b, *B. erythroloma*

c,d, *B. stirtonii*

e,f, *B. pseudocapillare*

g,h, *B. elegans*

i,j, *B. albo-limbatum*

k,l, *B. laevifilum*

m,n, *B. flaccidum*

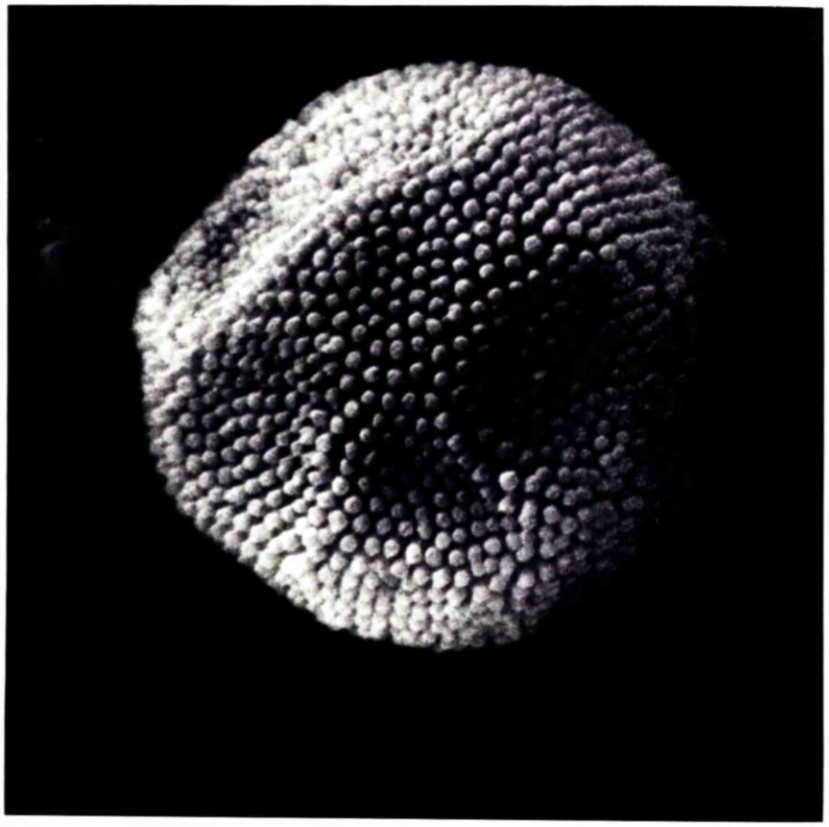
o,p, *B. jamaicanse*

q,r, *B. torquescens*

s,t, *B. capillare*

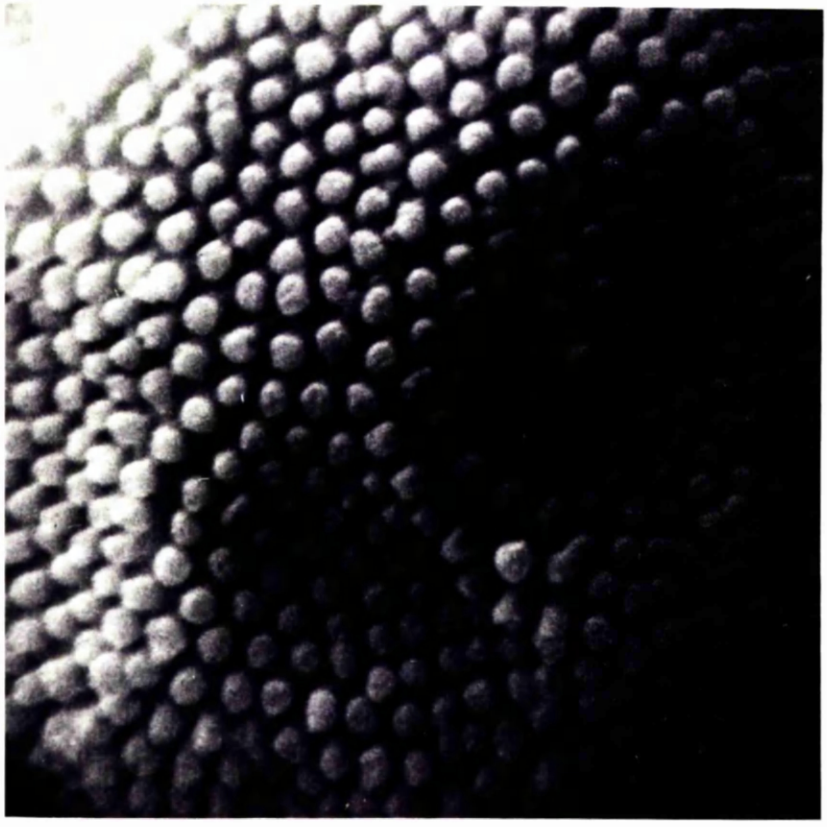
a

X 6 000



b

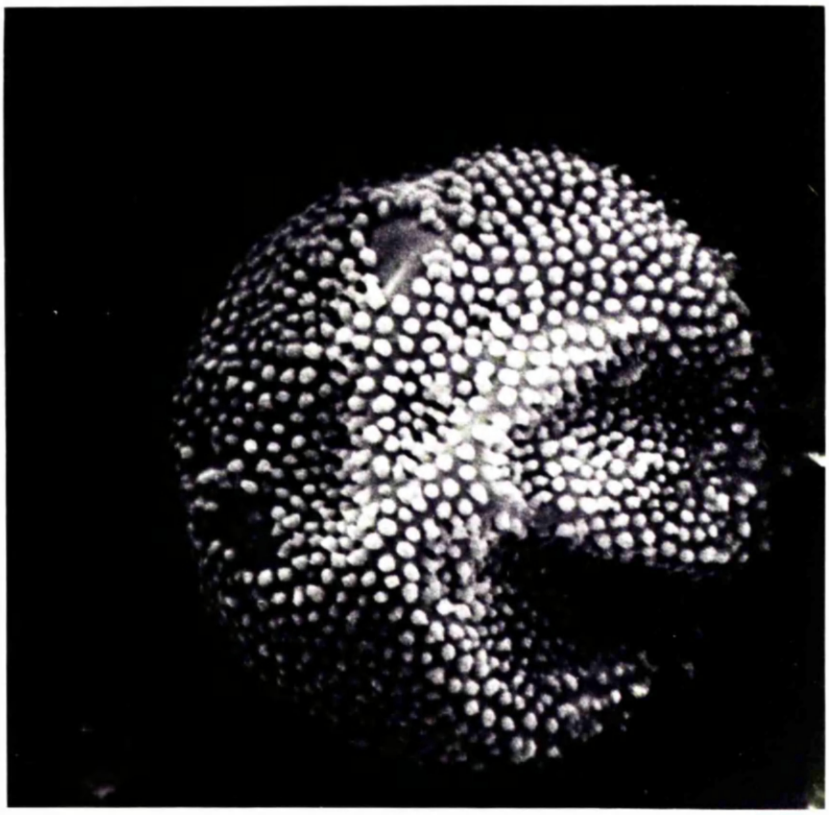
X 12000



B. erythroloma

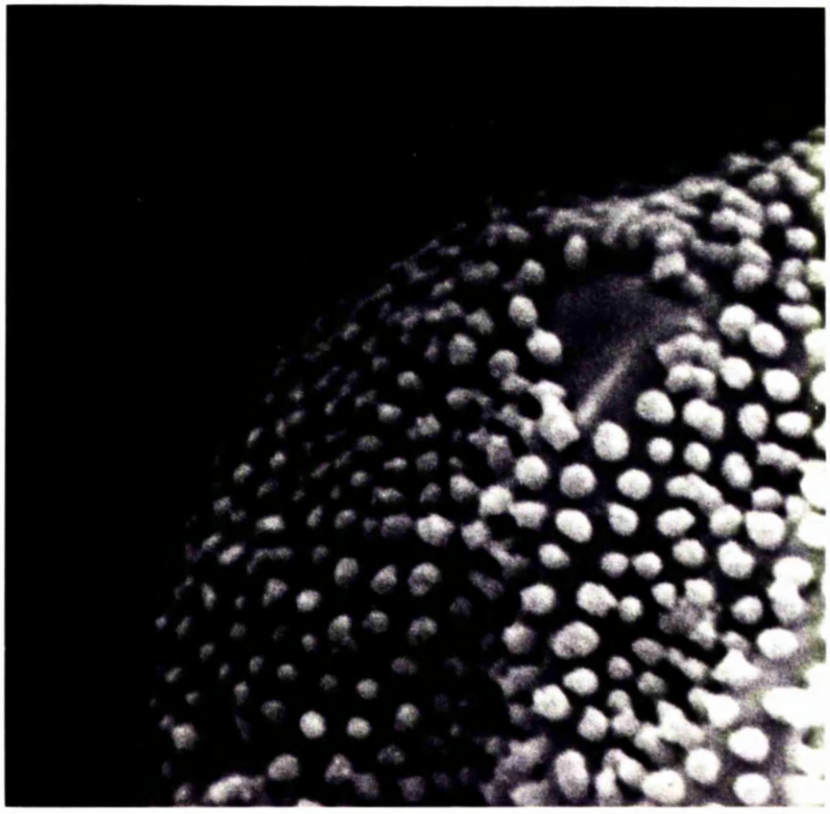
c

×6 000



d

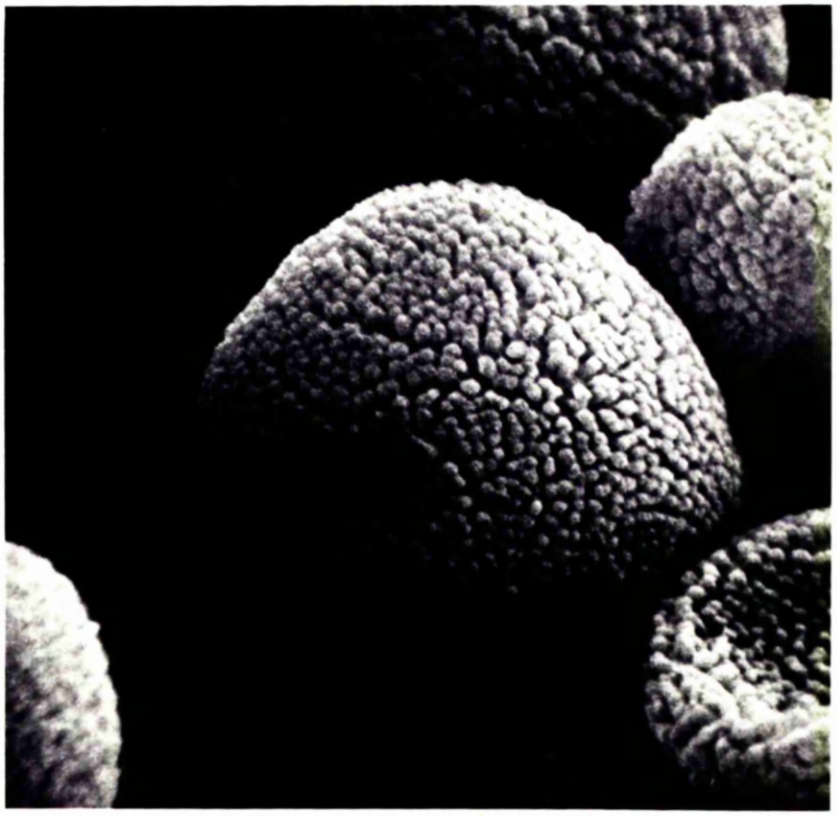
×12 000



B. stirtonii

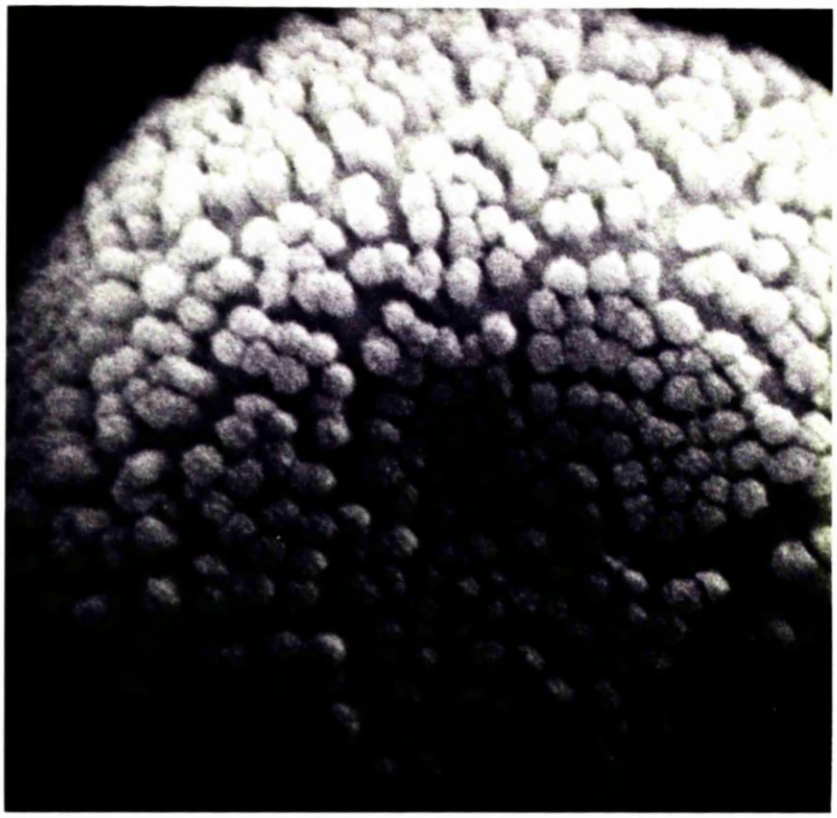
e

X 6 000



f

X 12 000



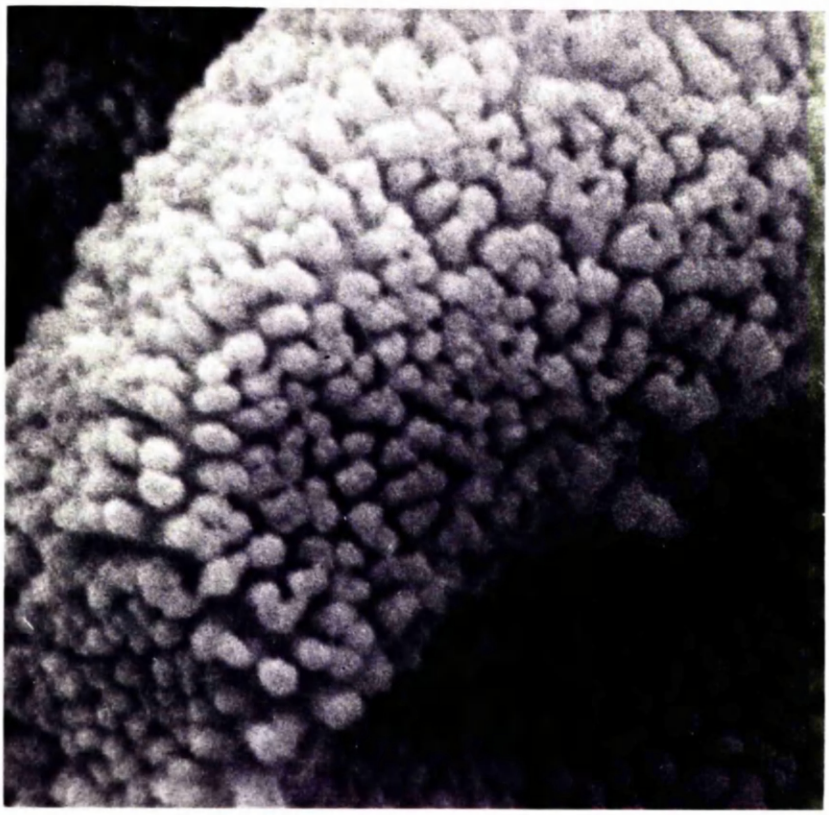
B. pseudocapillare

g

×6000

h

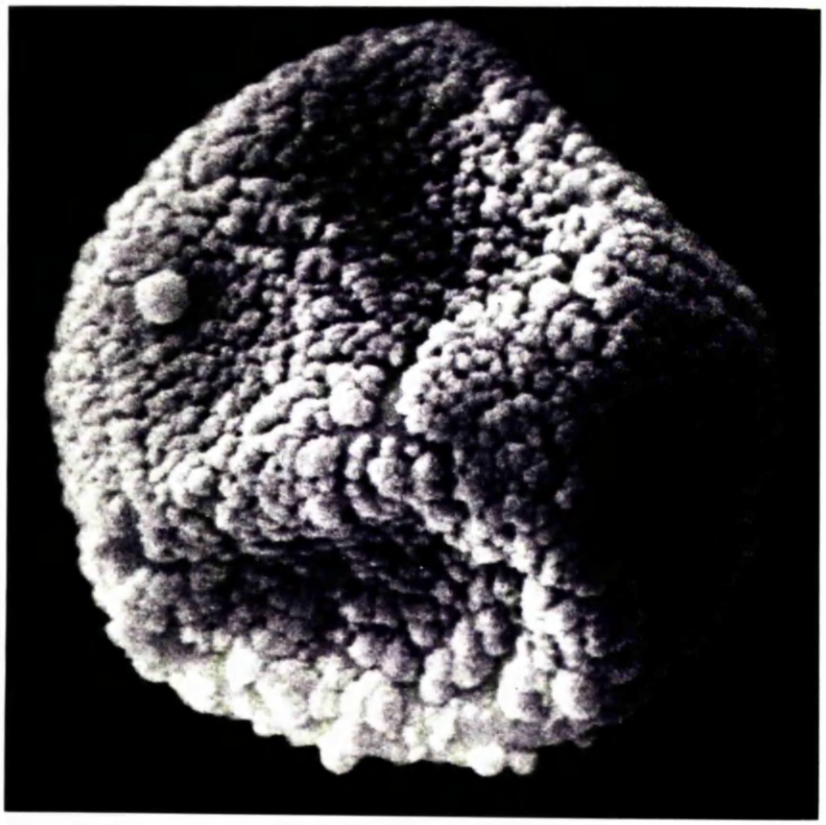
×12000



B. elegans

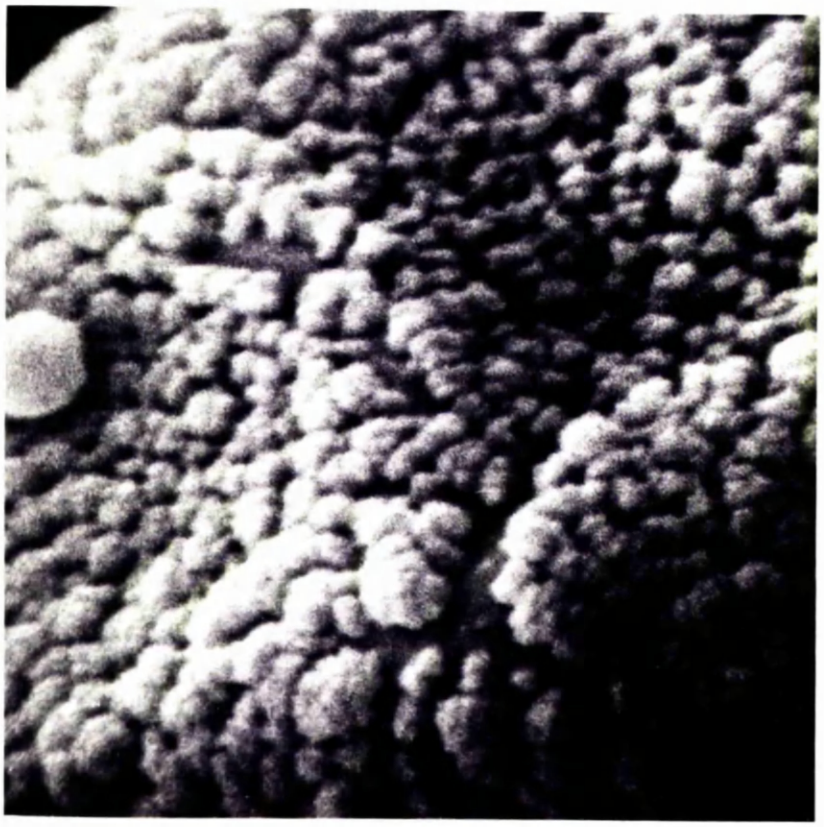
i

× 6 000



j

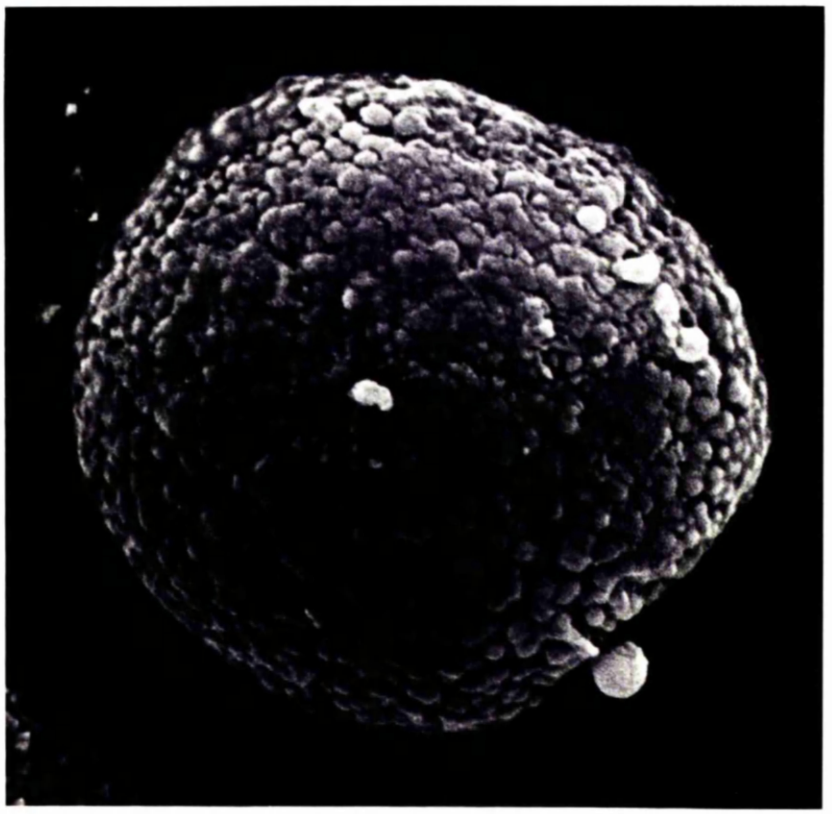
× 12 000



B. albo-limbatum

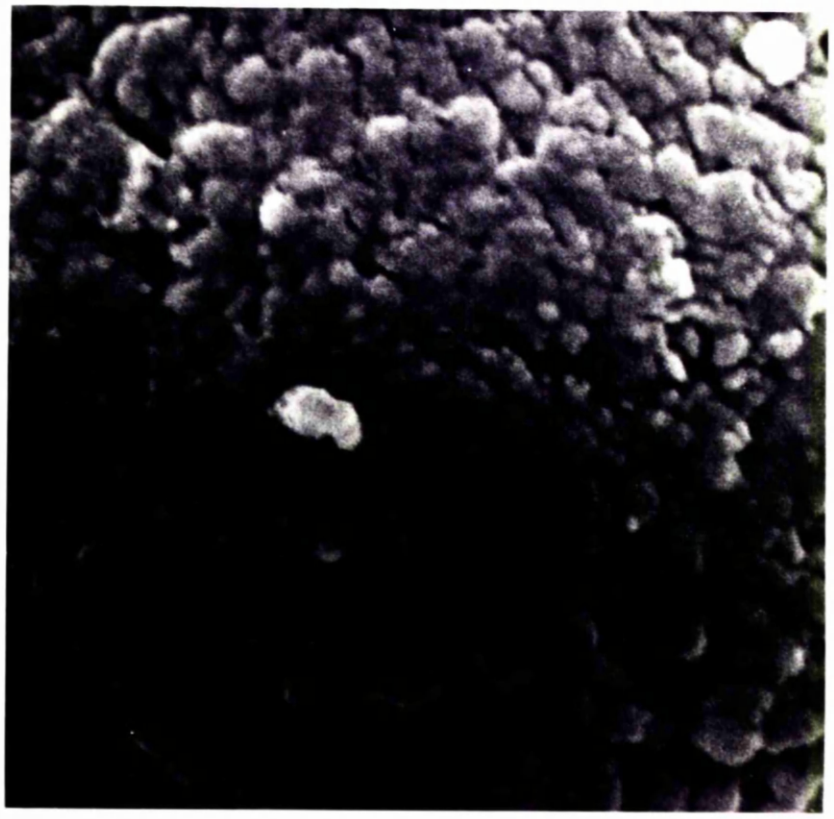
k

x 6000



l

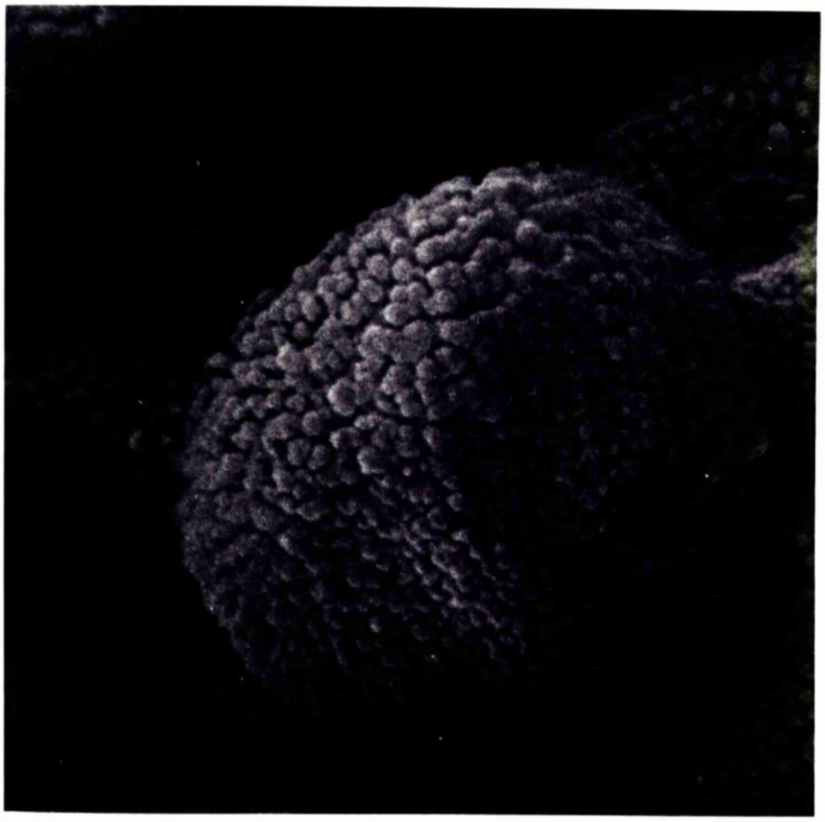
x 12000



B. laevifilum

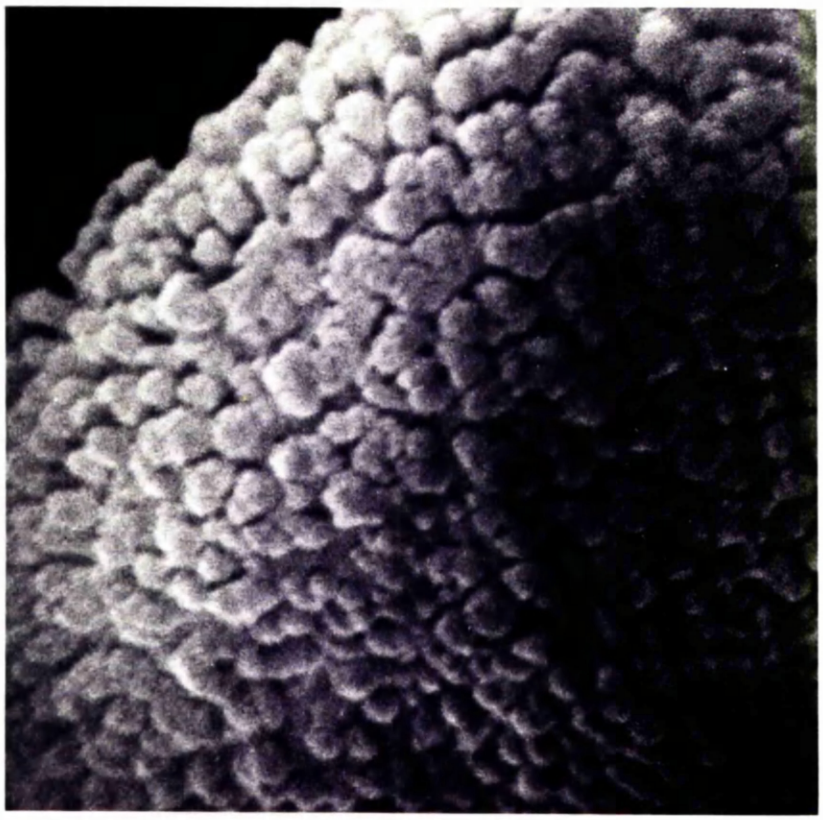
m

X 6 000



n

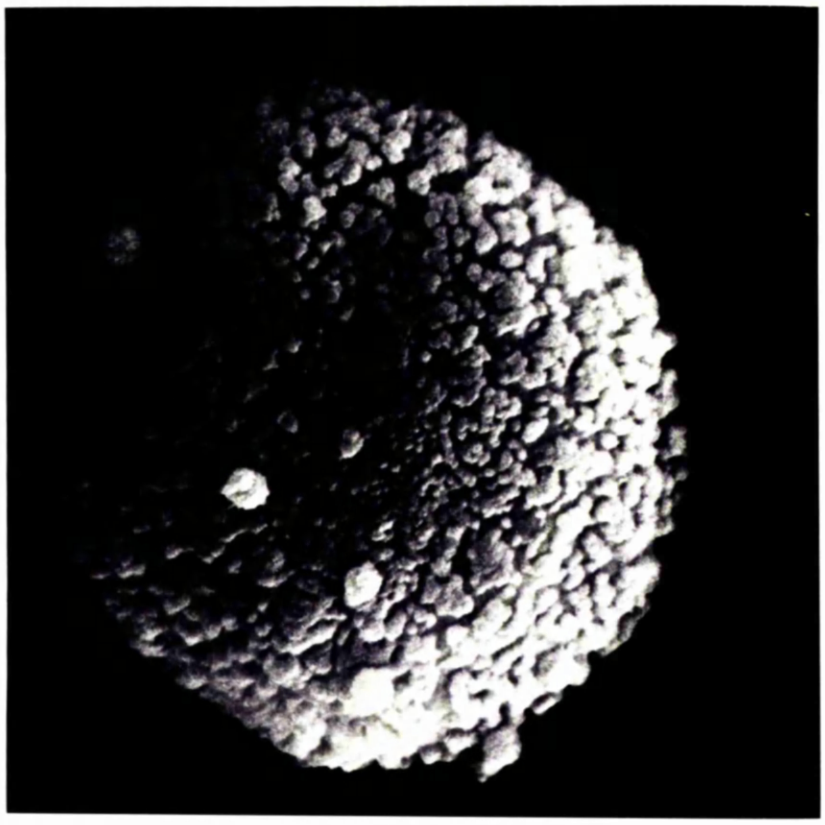
X 12000



B. flaccidum

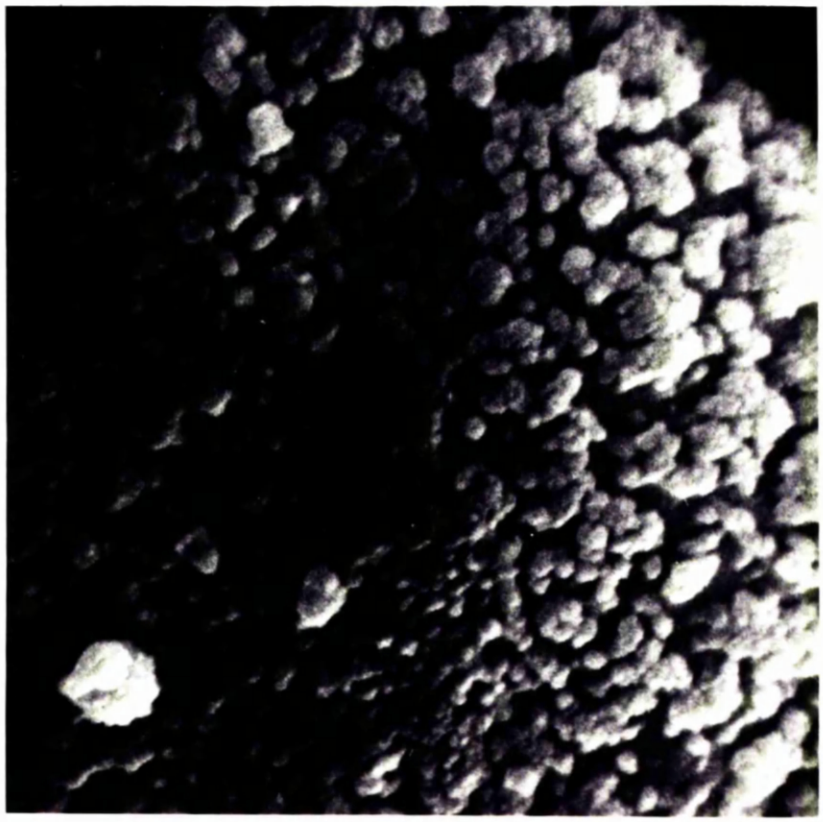
o

X 6000



p

X 12000



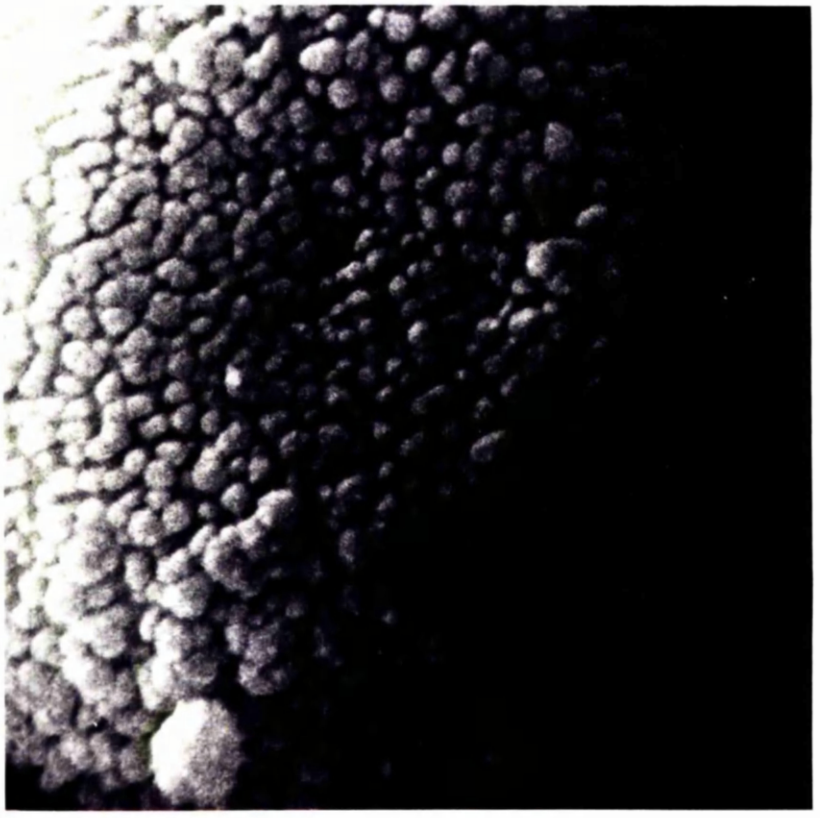
B. jamaicanse

q

x 6000

r

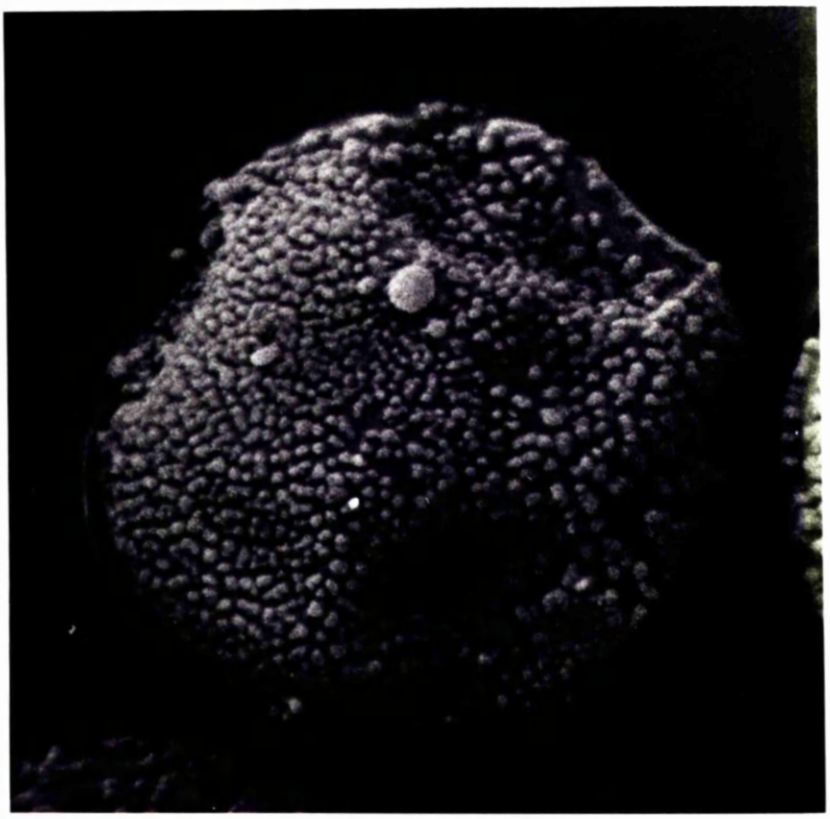
x 12000



B. torquescens

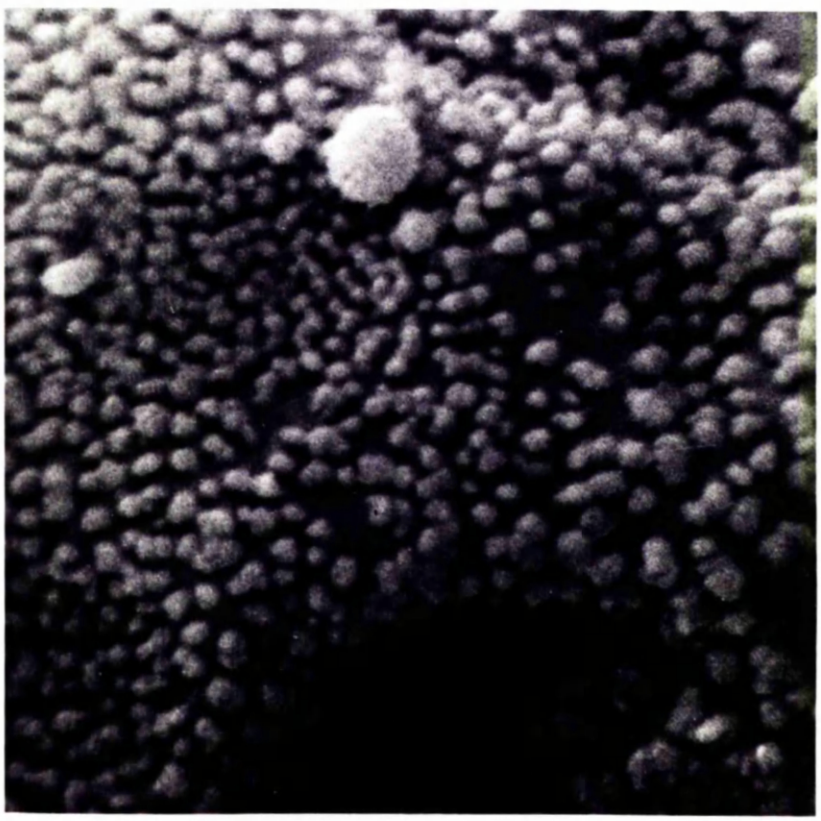
S

X 6000



t

X 12000



B. capillare

Fig. 32. Diagrams showing the distribution and arrangement of antheridia and perigonial leaves in the male heads:

a,b, *B. capillare* Hedw.; c, *B. erythroloma* (Kindb.) Syed.

d, *B. flaccidum* Brid.; e, *B. laevifilum* Syed;

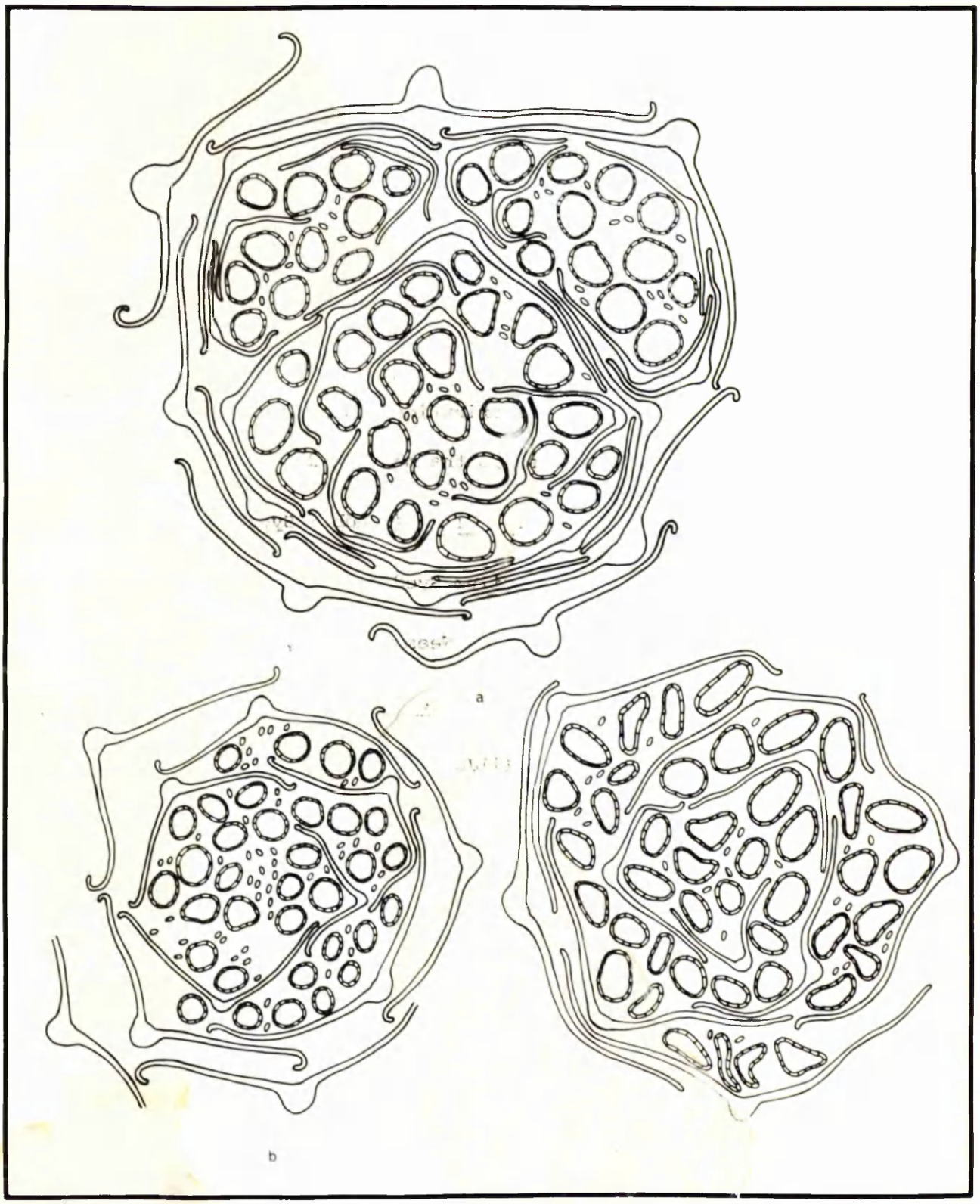
f, *B. stirtonii* Schimp.; g, *B. elegans* Nees ex Brid.;

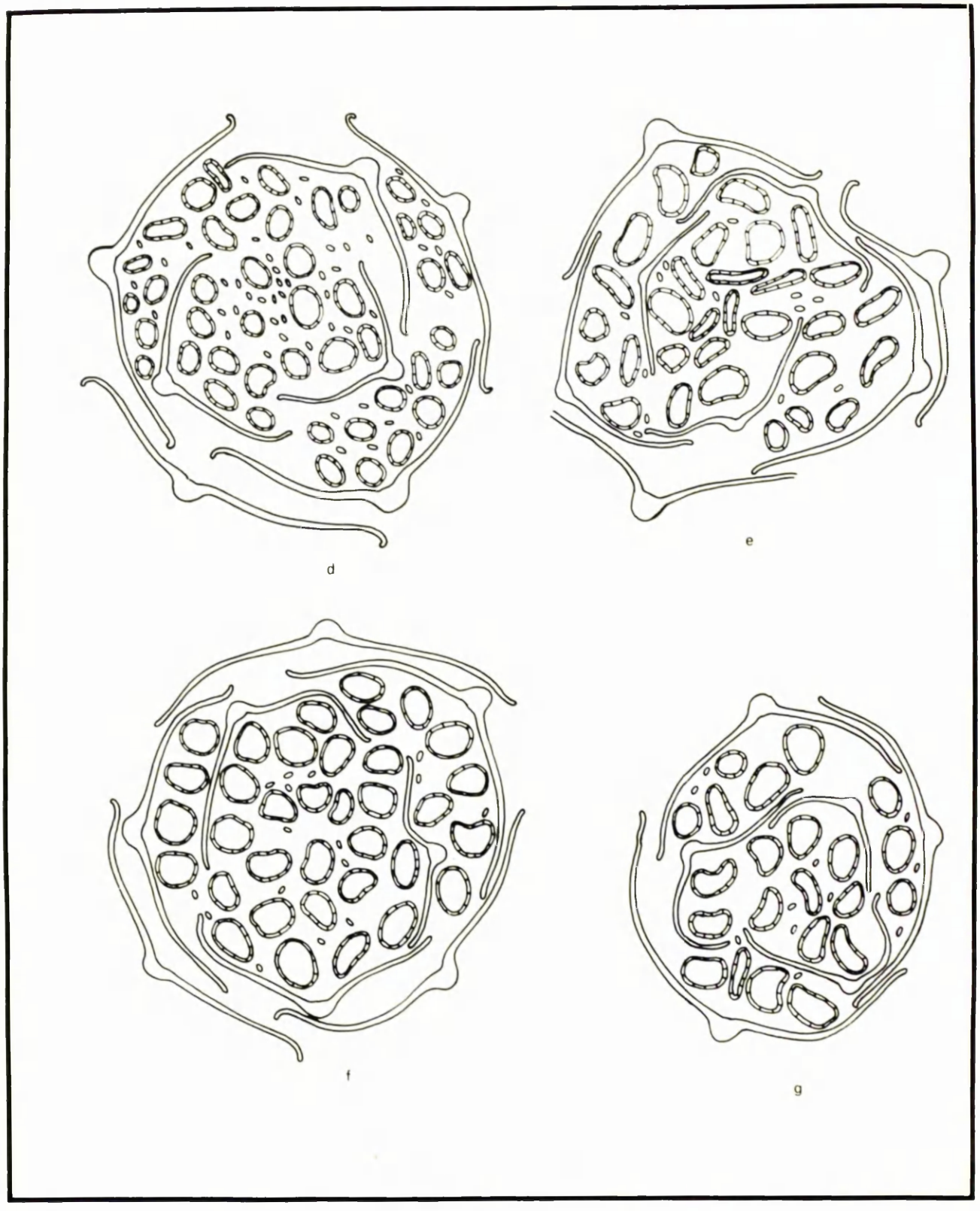
h, *B. torquescens* Bruch.; i, *B. jamaicanse* Syed;

j, *B. albo-limbatum* (Hamp. et C.Muell)Jaeg.;

k,l, *B. pseudocapillare* Besch.

a - l, x40.


a
b


d
e
f
g

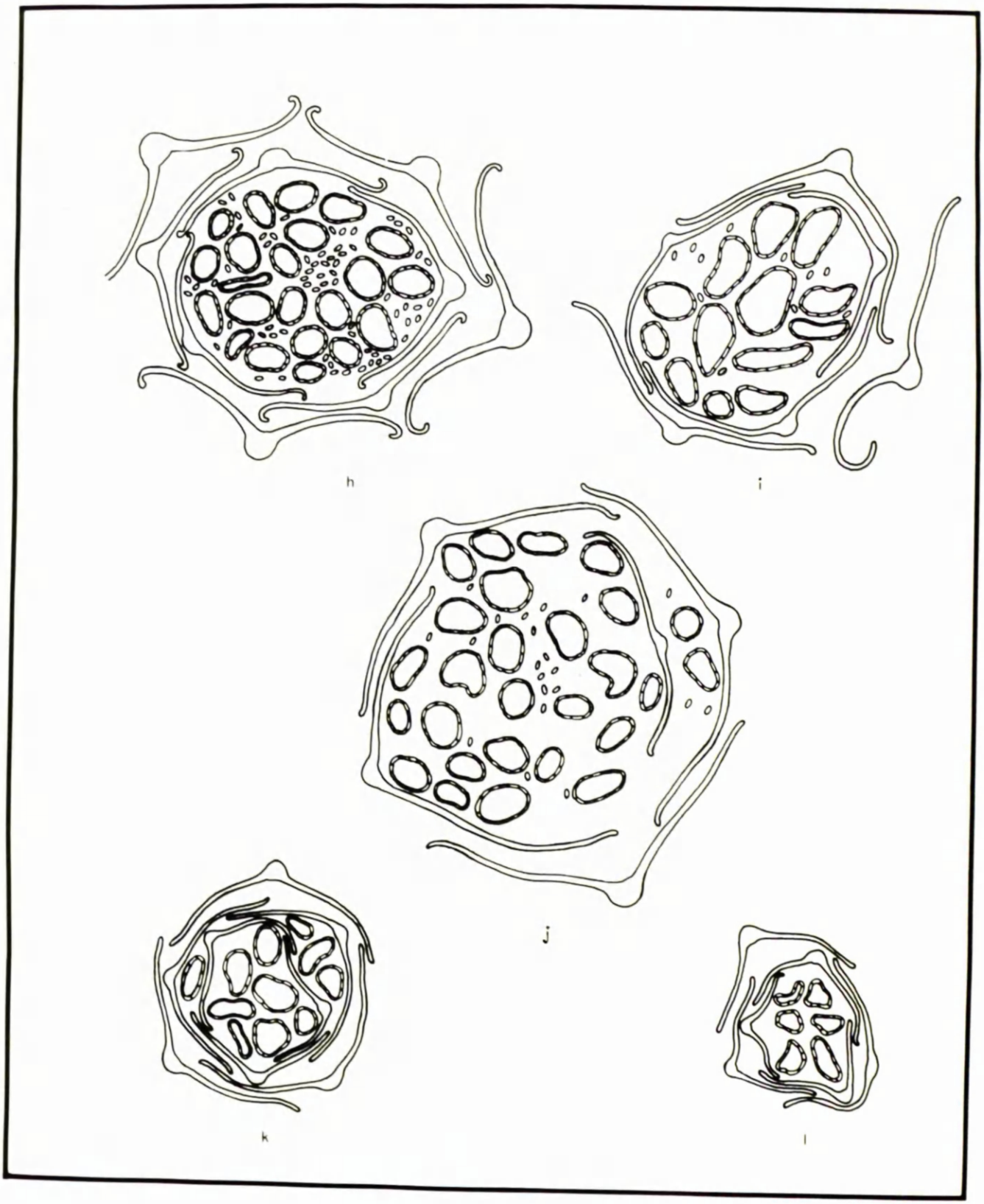
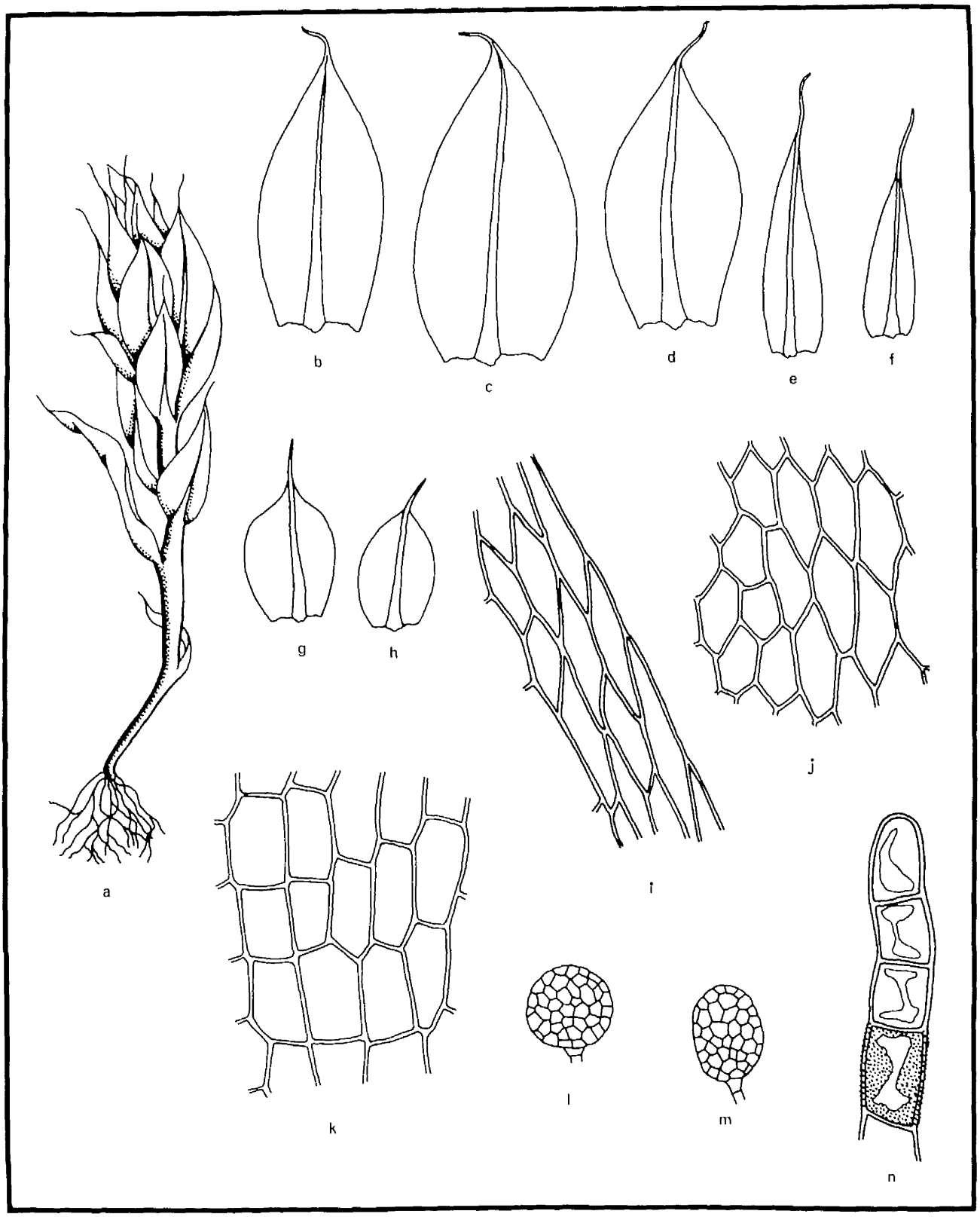

h
i
j
k
l

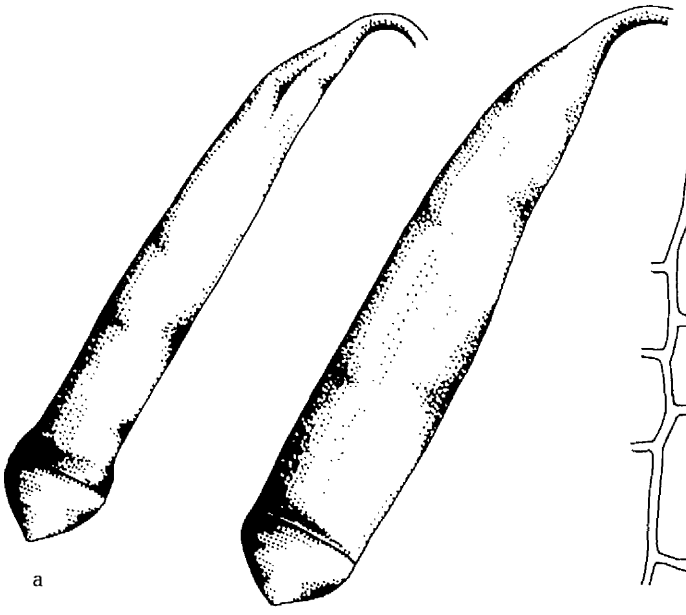
Fig. 33. *B. gemmascens* Kindb., a-m, from the type of *B. gemmascens*, n, from the type of *B. trichophorum* Kindb. a, plant dry; b-d, leaves; e,f, perichaetial leaves; g,h, perigonial leaves; i, cells at margin of leaf; j, cells in middle; k, cells at base; l,m, tubers, n, axillary gemma.

a-h, x15; i-k, n, x200; l,m, x50.



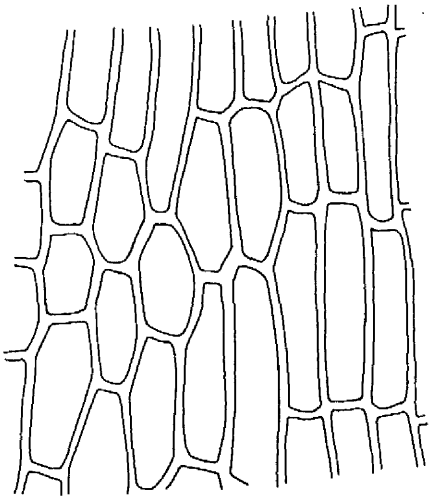
B. gemmascens

Fig. 34. *B. gemmascens* Kindb., from the type of *B. sanguilentum* Ren. et Card. a, dry capsule; b, same capsule moist; c, lid cells; d, cells at mouth of capsule; e, exothecial cells. a, b, x7.5; c-e, x200.

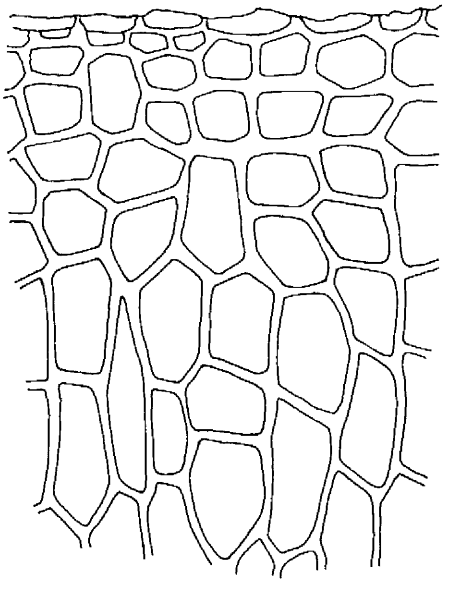


a

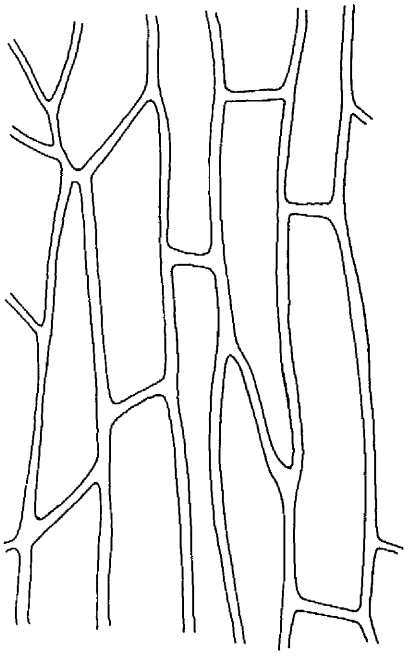
b



c



d



e

B. gemmascens

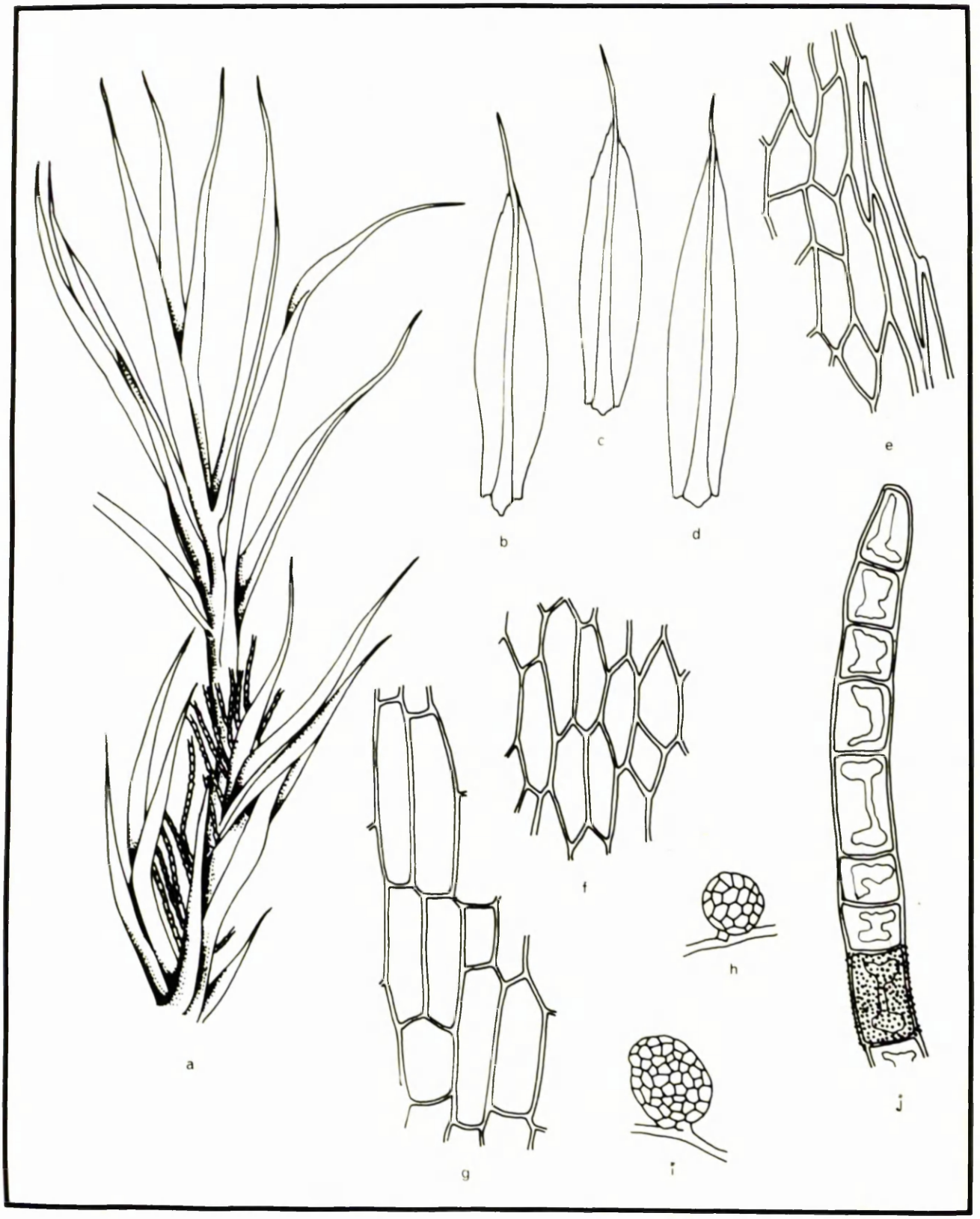
Fig. 35. B. moravicum Podp., from the type.

a, plant dry; b-d, leaves; e, cells at margin of leaf;

f, cells in middle; g, cells at base; h,i, tubers;

j, axillary gemma.

a-d, x15; e-g, j, x200; h,i, x50.



B. moravicum

Fig. 36. Map showing the distribution of B. erythroloma and B. jamaicanse.

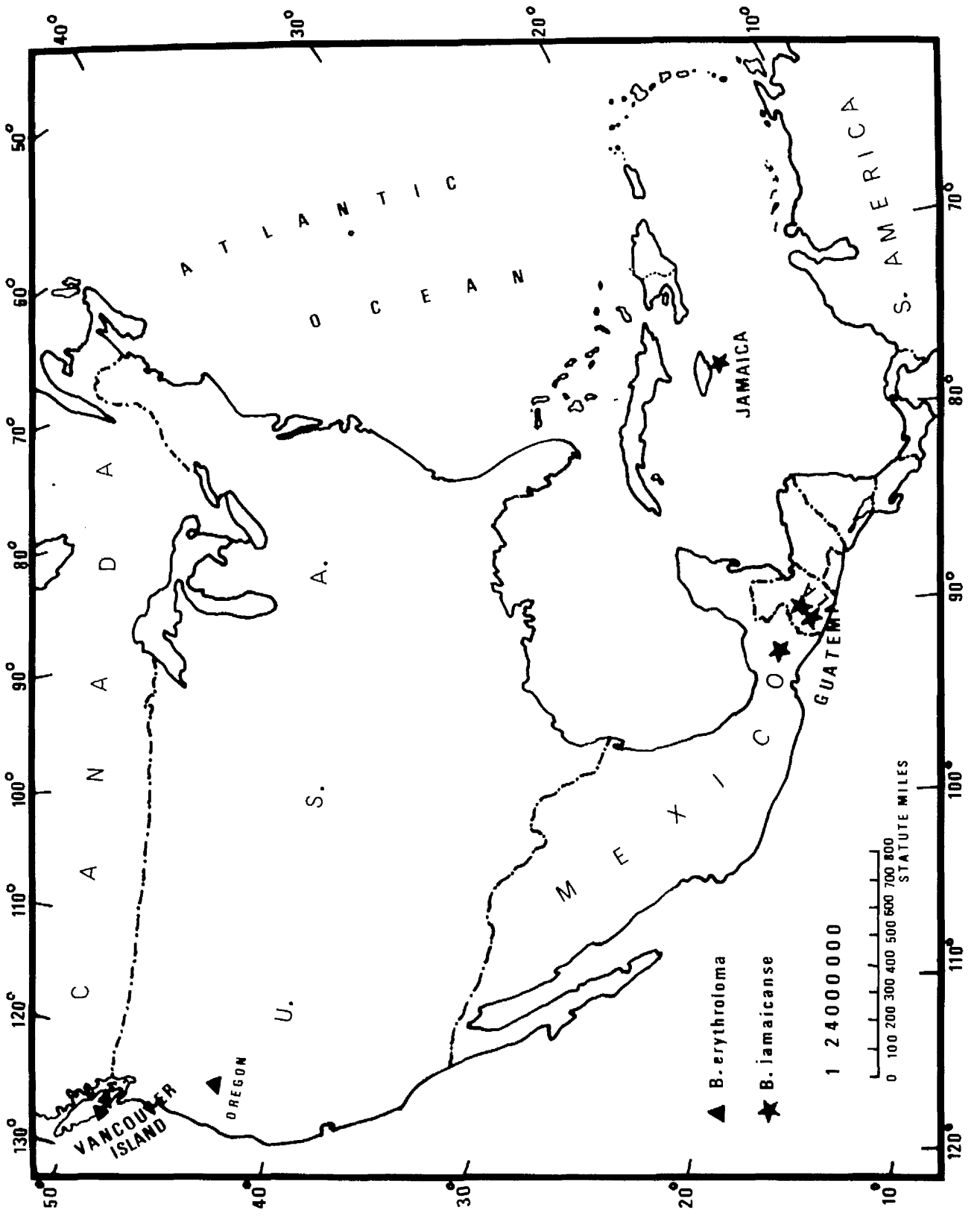
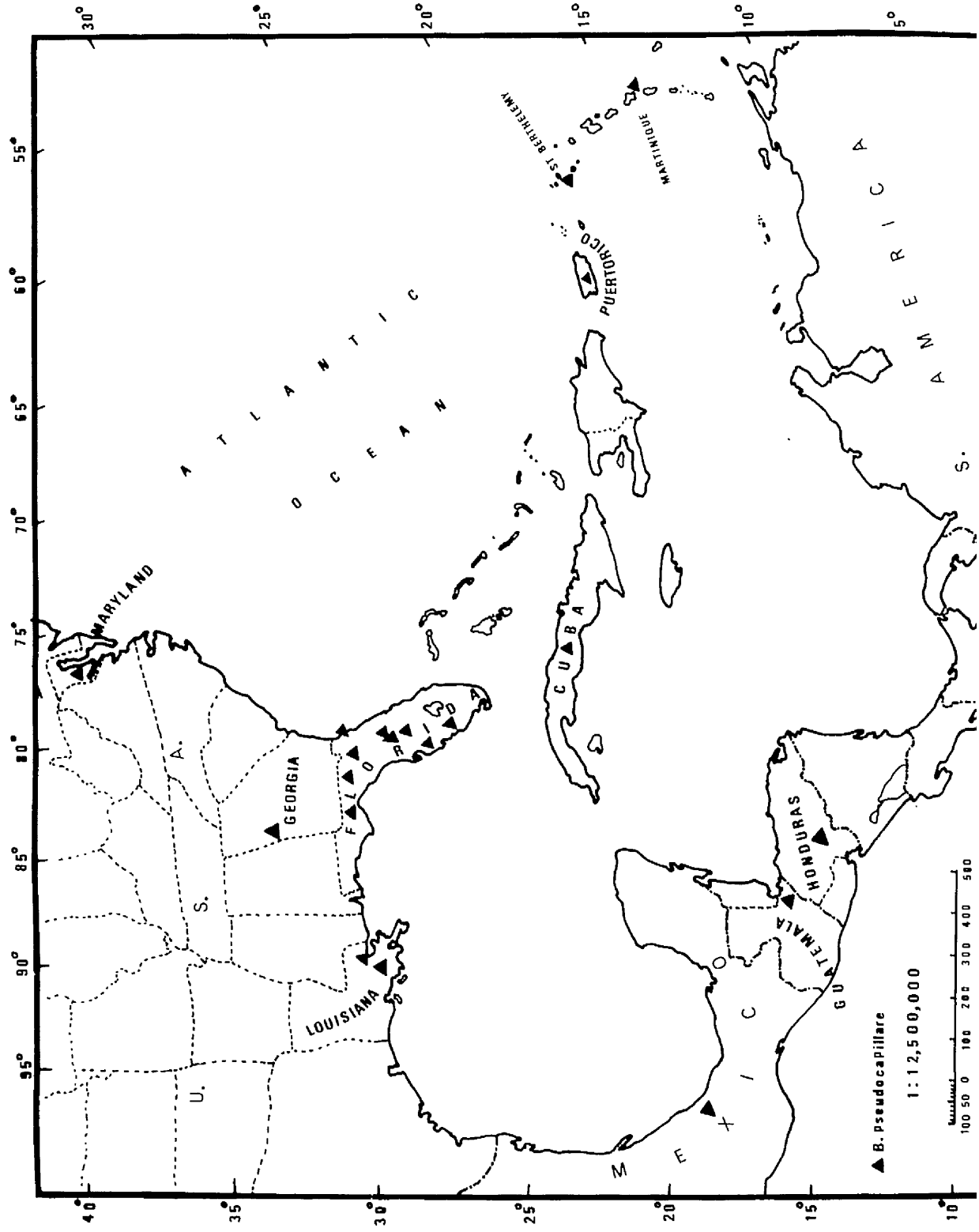

ATLANTIC
OCEAN
CANADA
U.S.A.
MEXICO
S. AMERICA
JAMAICA
GUATEMALA
VANCOUVER ISLAND
OREGON
B. erythroloma
B. jamaicanse
1 24000000
0 100 200 300 400 500 600 700 800
STATUTE MILES

Fig. 37. Map showing the distribution of

B. pseudocapillare.


ATLANTIC OCEAN
MARYLAND
GEORGIA
FLORIDA
LOUISIANA
U. S. A.
CUBA
PUERTO RICO
ST. BERTHELEMY
MARTINIQUE
HONDURAS
GUATEMALA
MEXICO
S. AMERICA
B. Pseudocapillare
1:12,500,000
100 50 0 100 200 300 400 500